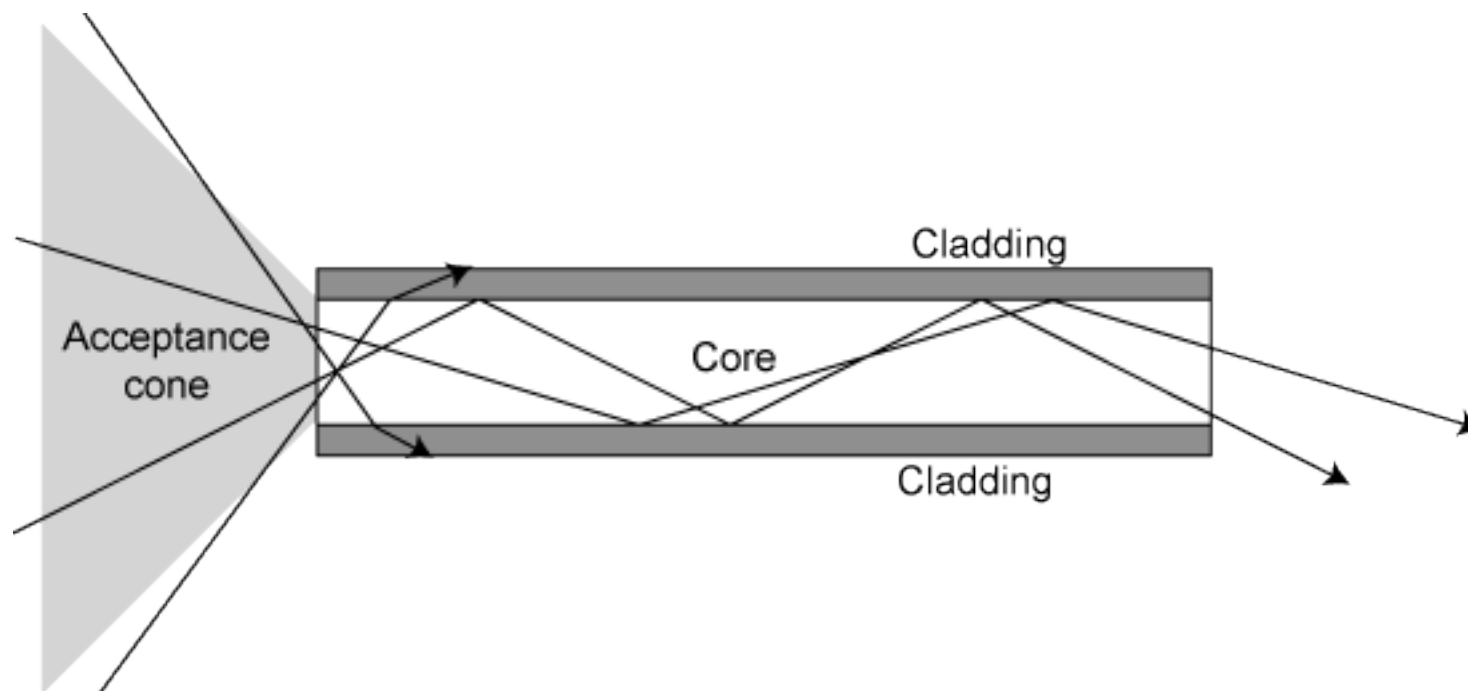


Simulation of Light Collection



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HCal WorkFest, GSU, Atlanta

OptiCAD

INTRODUCTION

OptiCAD is a computer program for the layout and analysis of three-dimensional optical systems. The program is structured in a computer-aided design (CAD) format in which the user defines objects, then places and orients them in a global-coordinate system. The program may be used to simulate a wide variety of nonimaging and imaging optical systems.

Components include spherical and cylindrical lenses; conical, parabolic, elliptical, spherical, and flat mirrors; full (closed) cylinders and ellipsoids; transmitting and reflecting rods; parabolic and elliptical troughs; single- and double-sided reflective surfaces; apertures of finite extent; lightpipes; multiple sources and detectors; compound parabolic concentrators; Fresnel lenses; and polygonally faceted objects (that may be translated from a CAD program).

OptiCAD

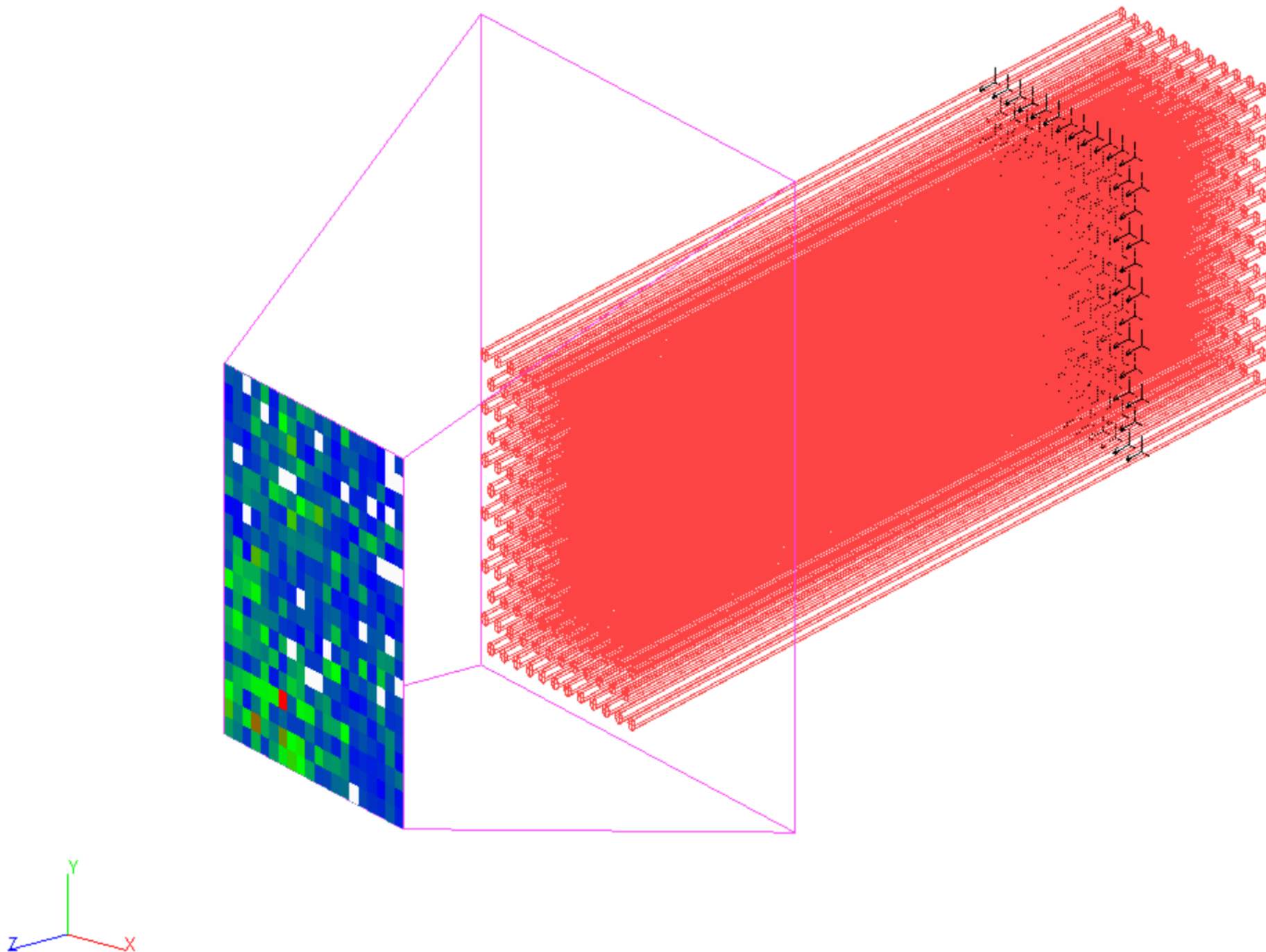
PRO:

- many predefined objects, lenses, mirrors, ...
- a lot of material details, mainly glass, every surface can be modified reflection, absorption, scattering,
- can measure impact hits and intensities like a film
- can read in CAD layout

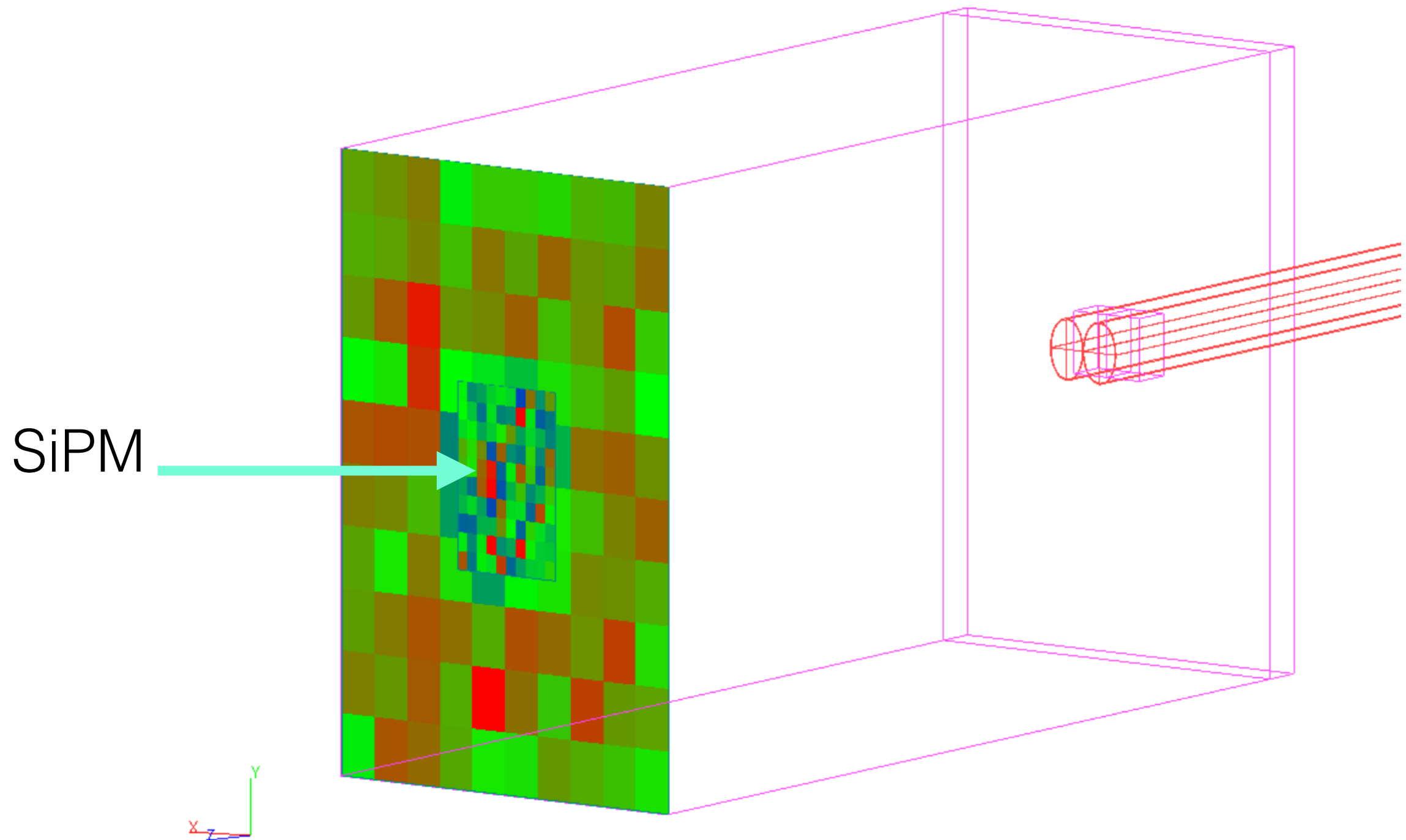
CONS:

- linear coding, no variables, loops ... every item has to be specifically coded
- overwhelming choices
- using CAD drawings treats the surface like finite element analysis, i.e. lots of surface, VERY slow.
- my version only runs under XP with a USB verification dongle, \$\$\$\$\$\$

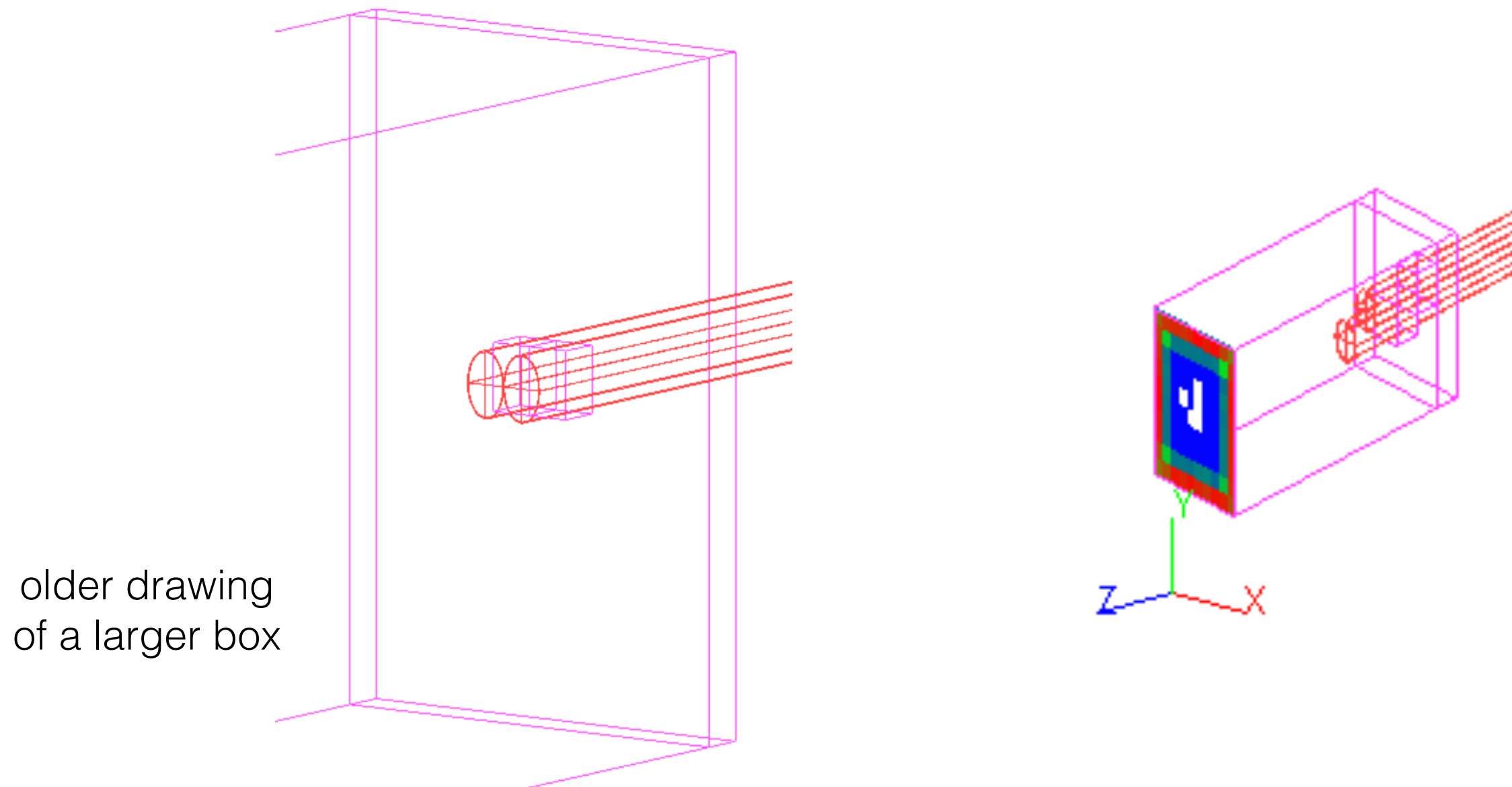
example one quarter of an EMCal tower
the macro is written by a perl script ...



started with something very simple, two fibers into a box with a simulated $3 \times 3 \text{ mm}^2$ SiPM and a surrounding back screen both have a grid readout



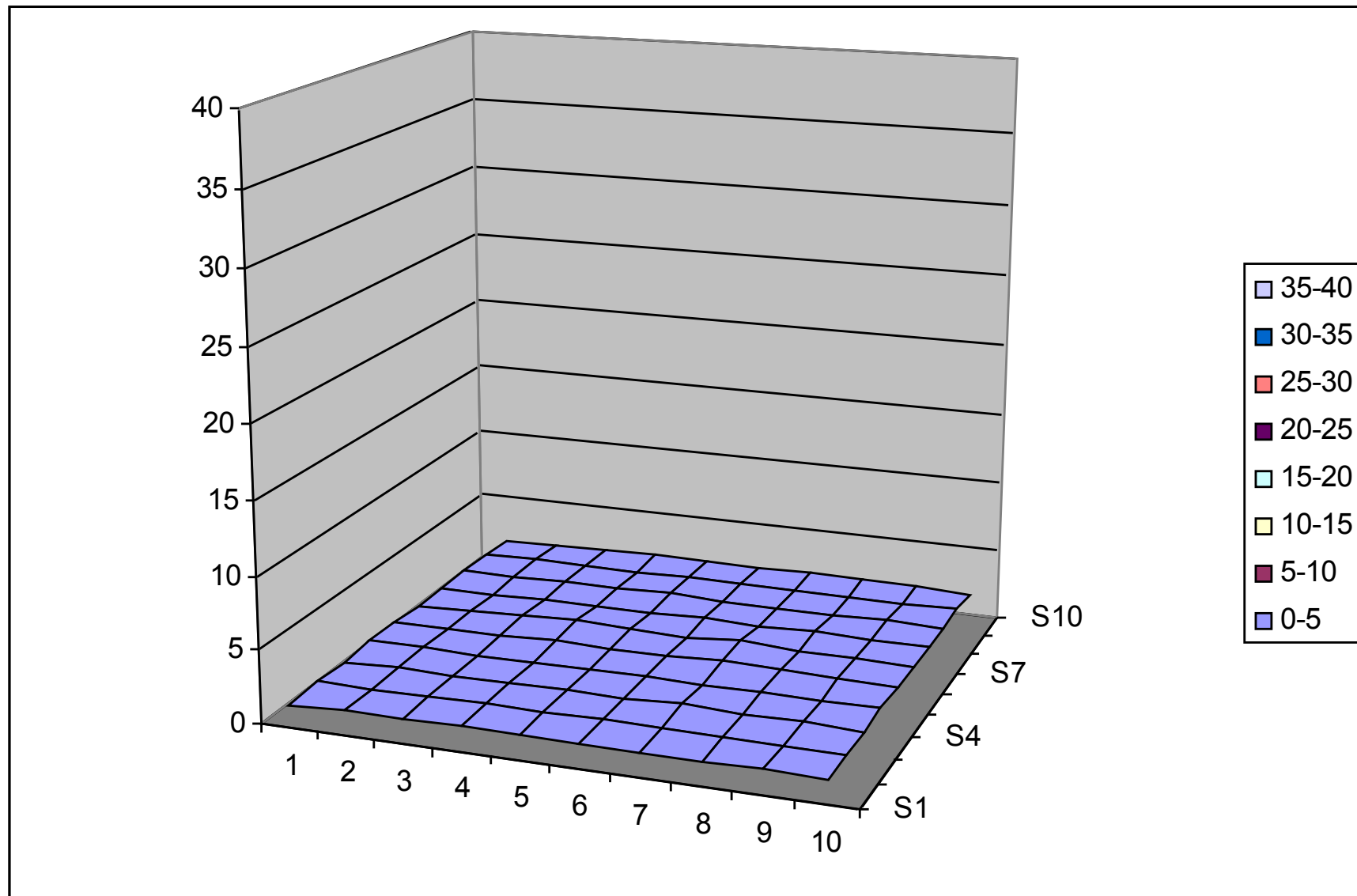
Compare different length of a square $4 \times 4 \text{ mm}^2$ box
two 1mm fibers arranged parallel or diagonal
fibers are just cylinders, core and cladding, with the correct
refractive index and a light source inside emitting light towards
the box (old drawing the fibers are flush with the lid)



light distribution on SiPM, 10x10grid

30mm

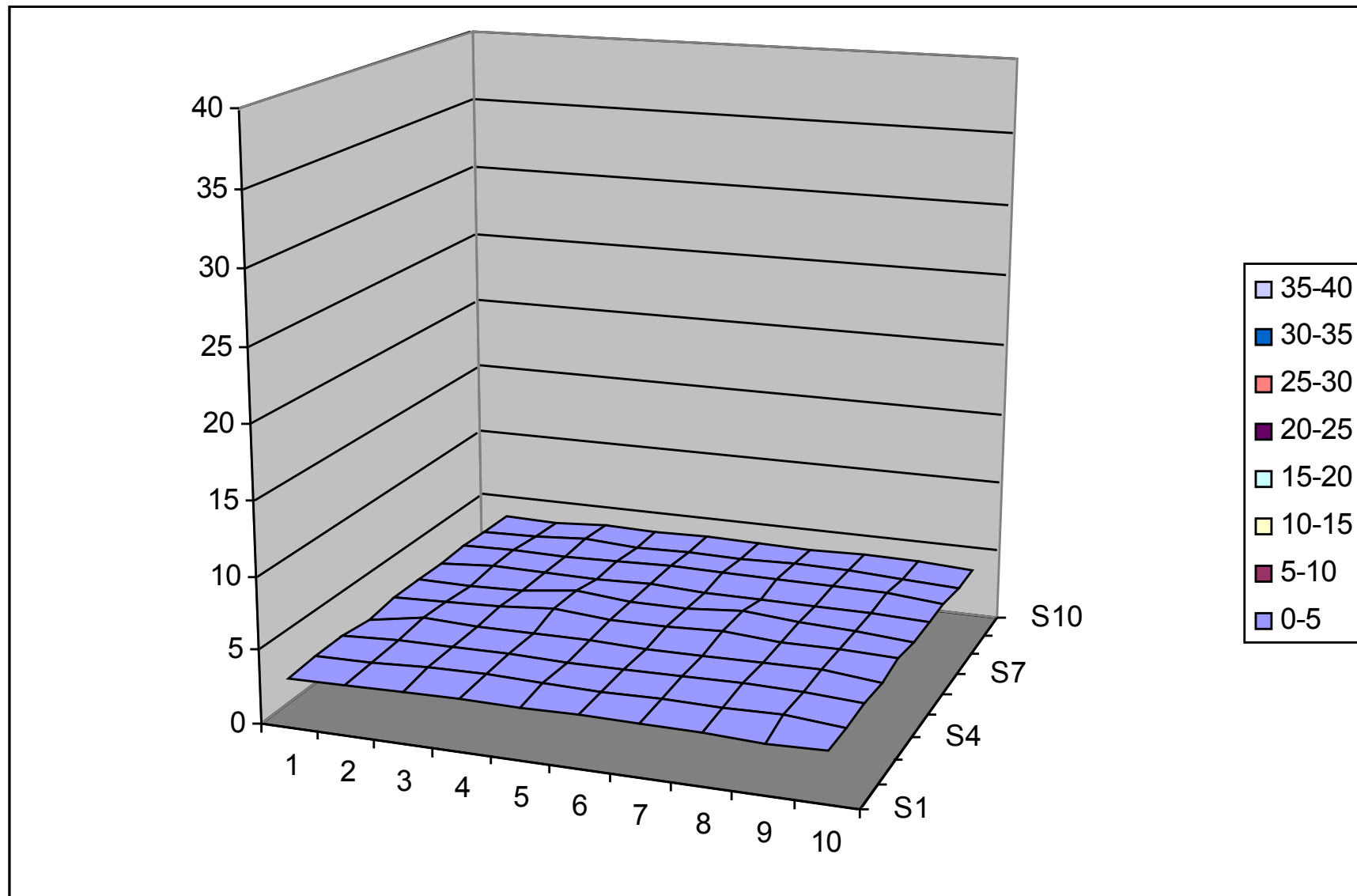
parallel fibers



light distribution on SiPM, 10x10grid

20mm

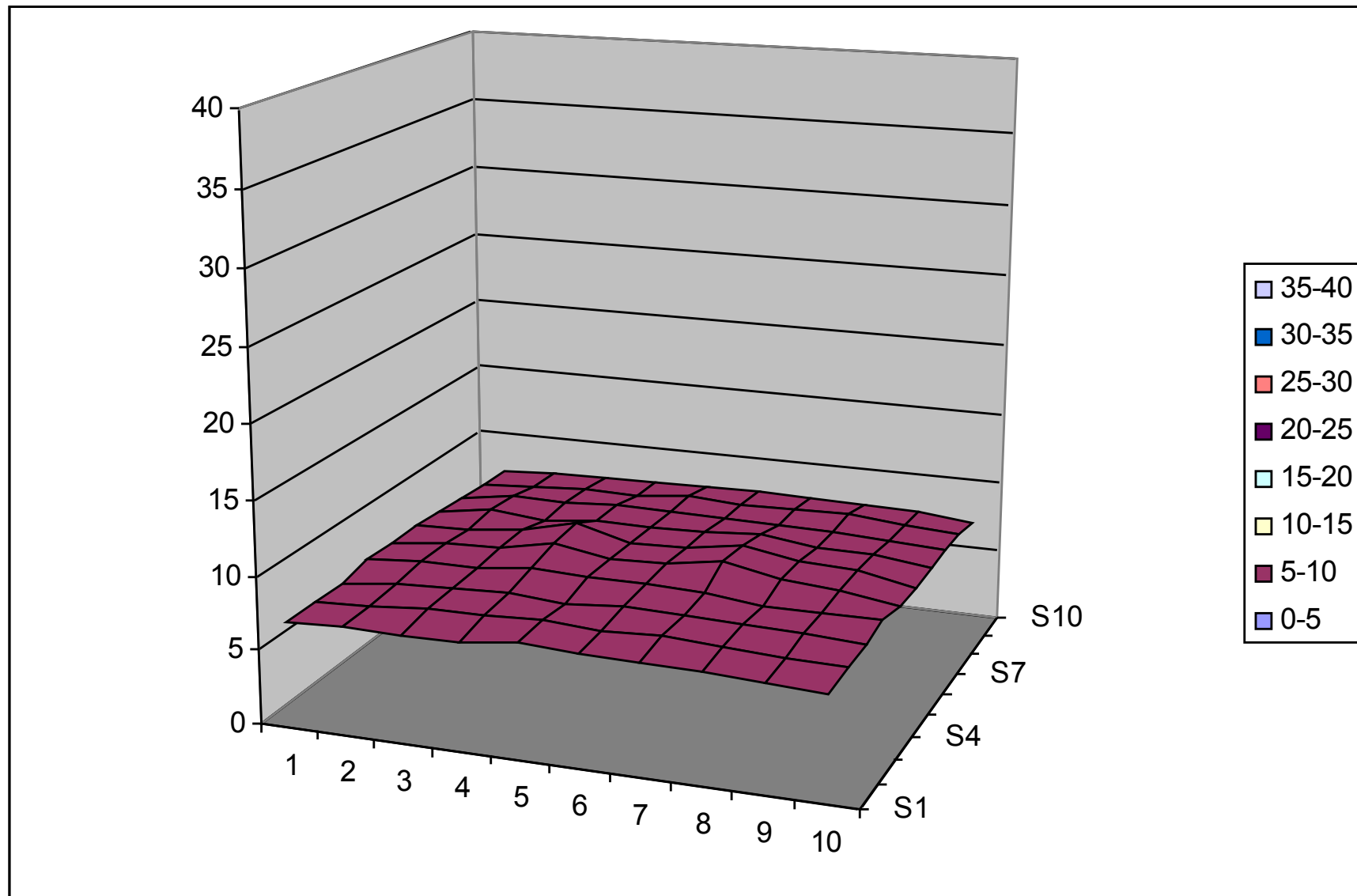
parallel fibers



light distribution on SiPM, 10x10grid

10mm

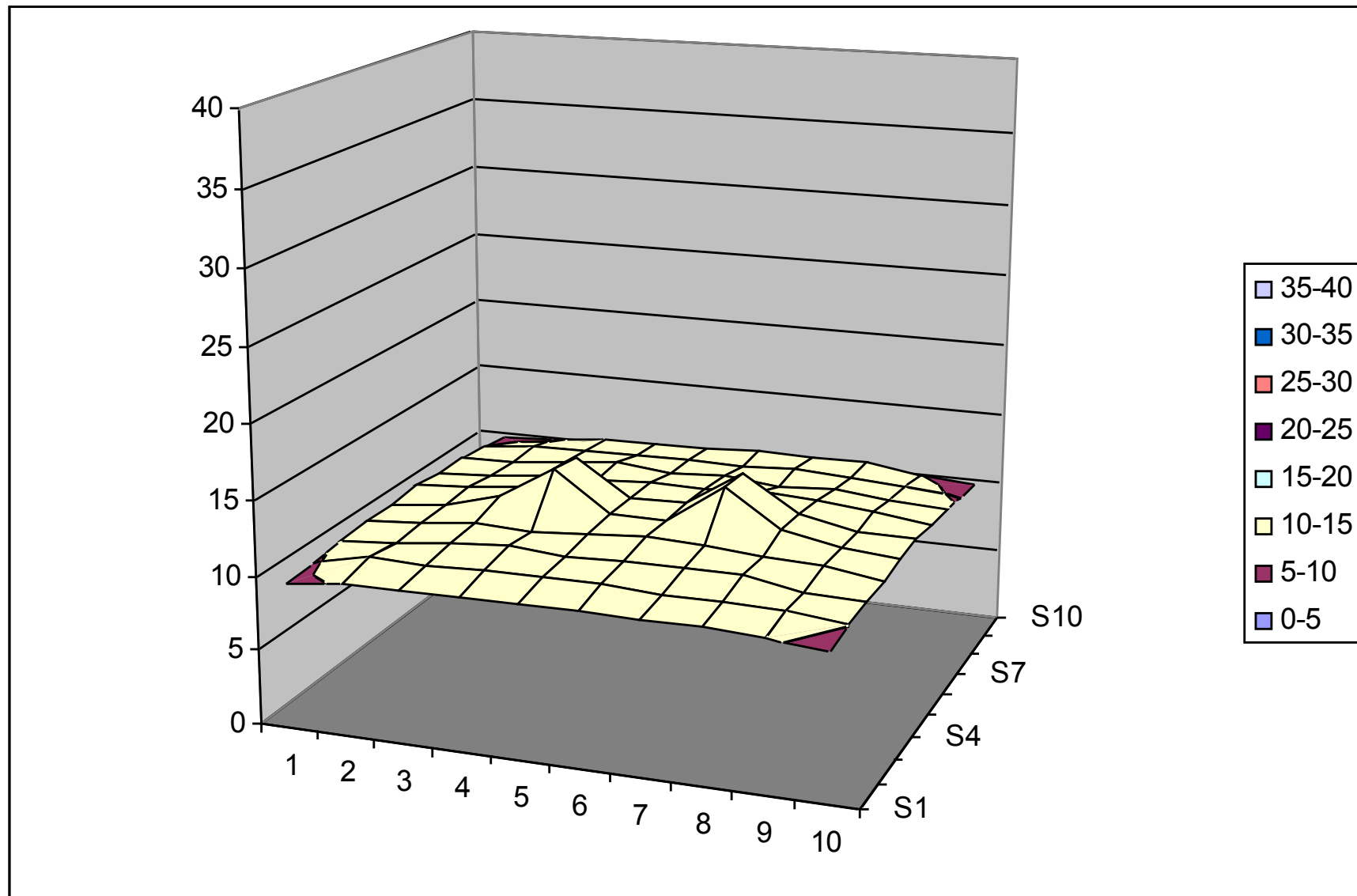
parallel fibers



light distribution on SiPM, 10x10grid

5 mm

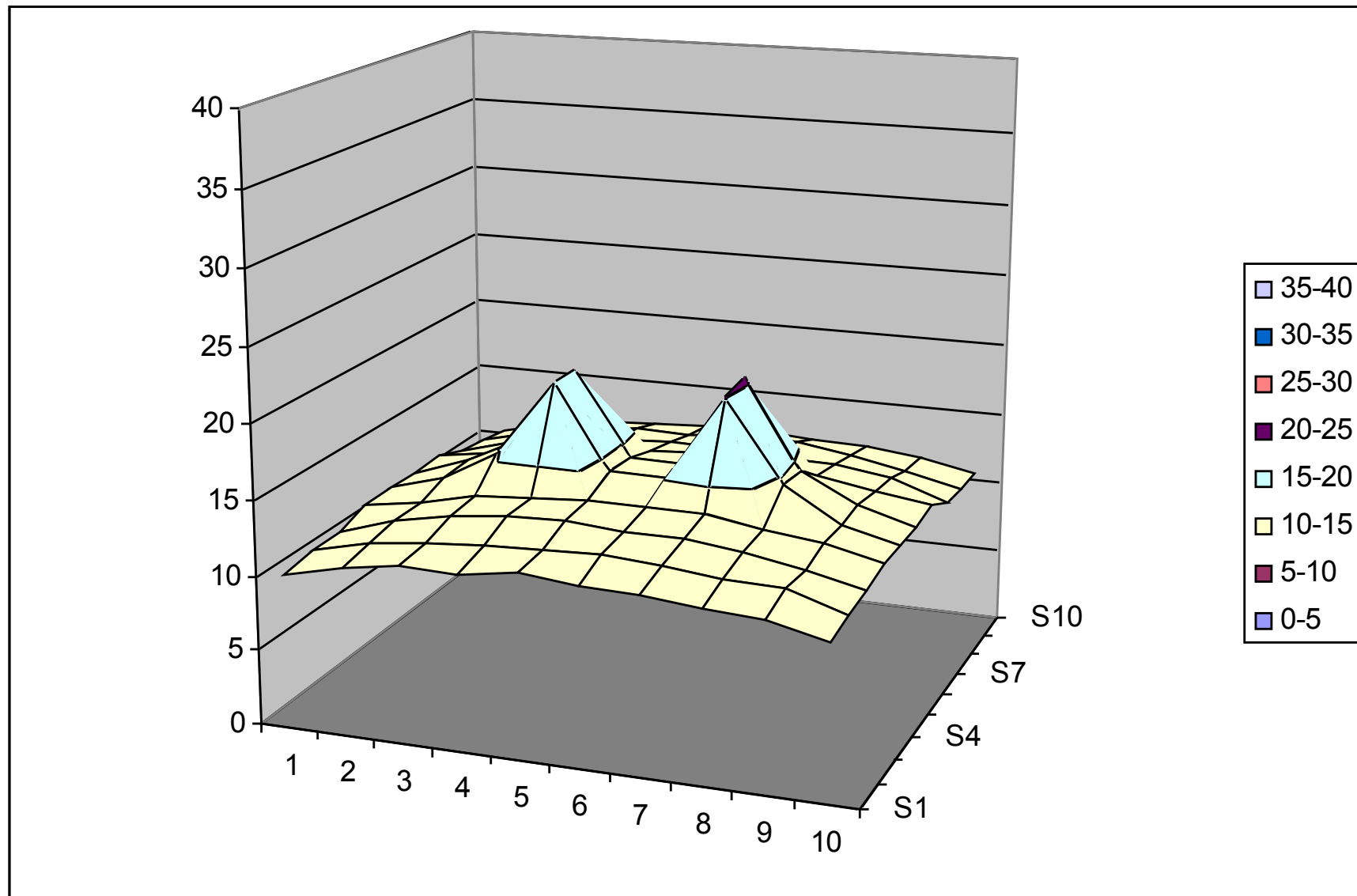
parallel fibers



light distribution on SiPM, 10x10grid

3mm

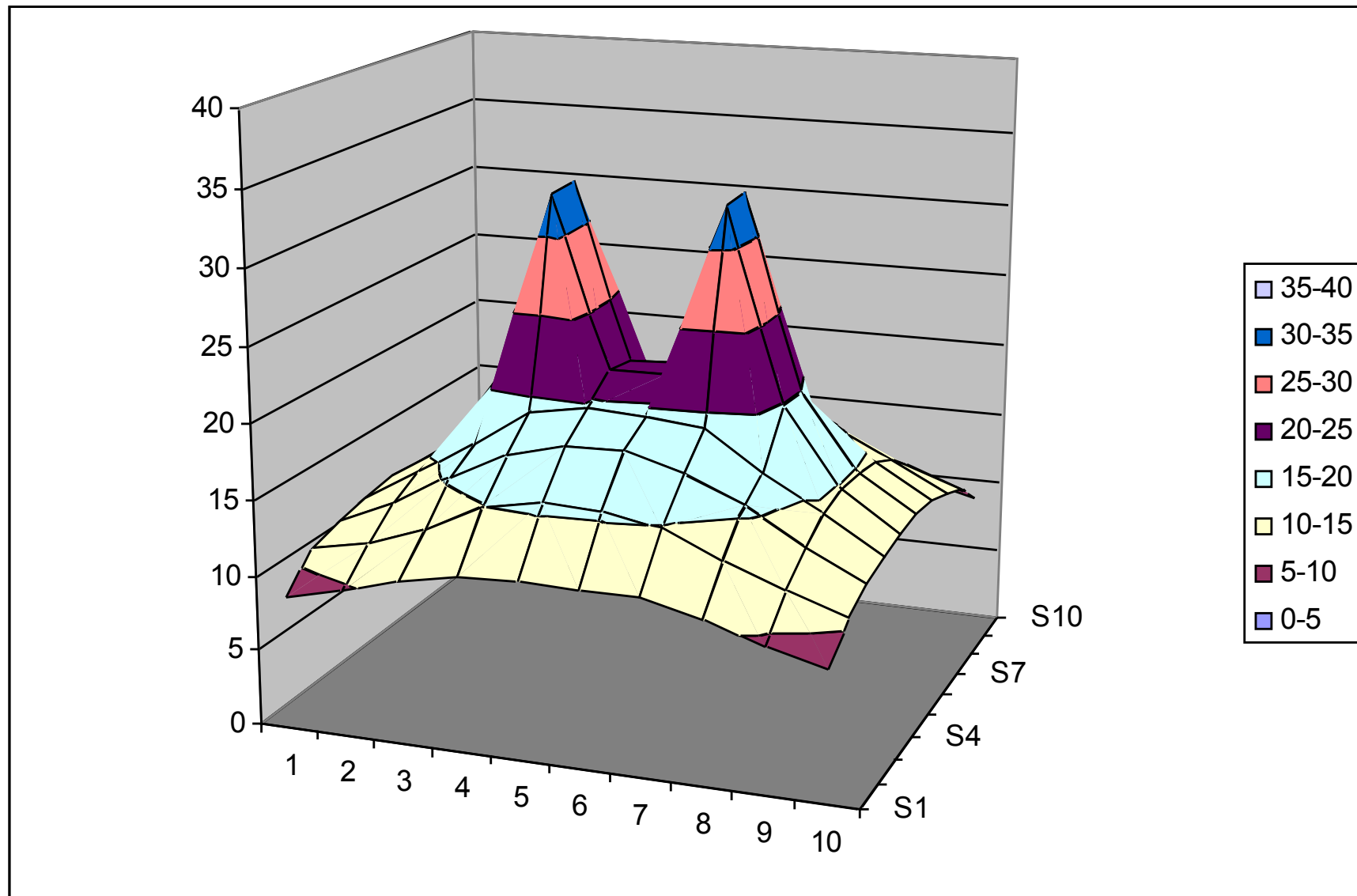
parallel fibers



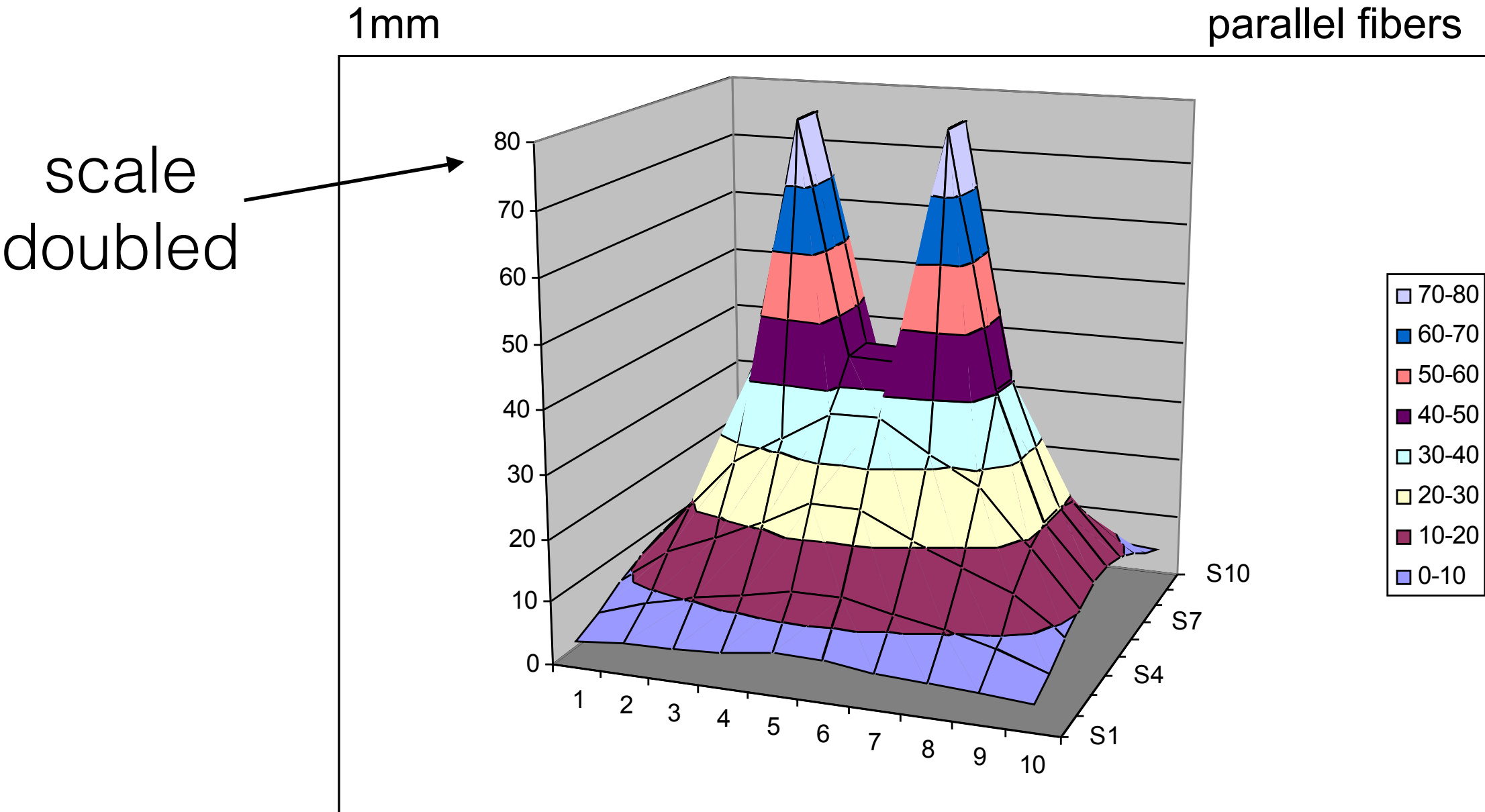
light distribution on SiPM, 10x10grid

2mm

parallel fibers



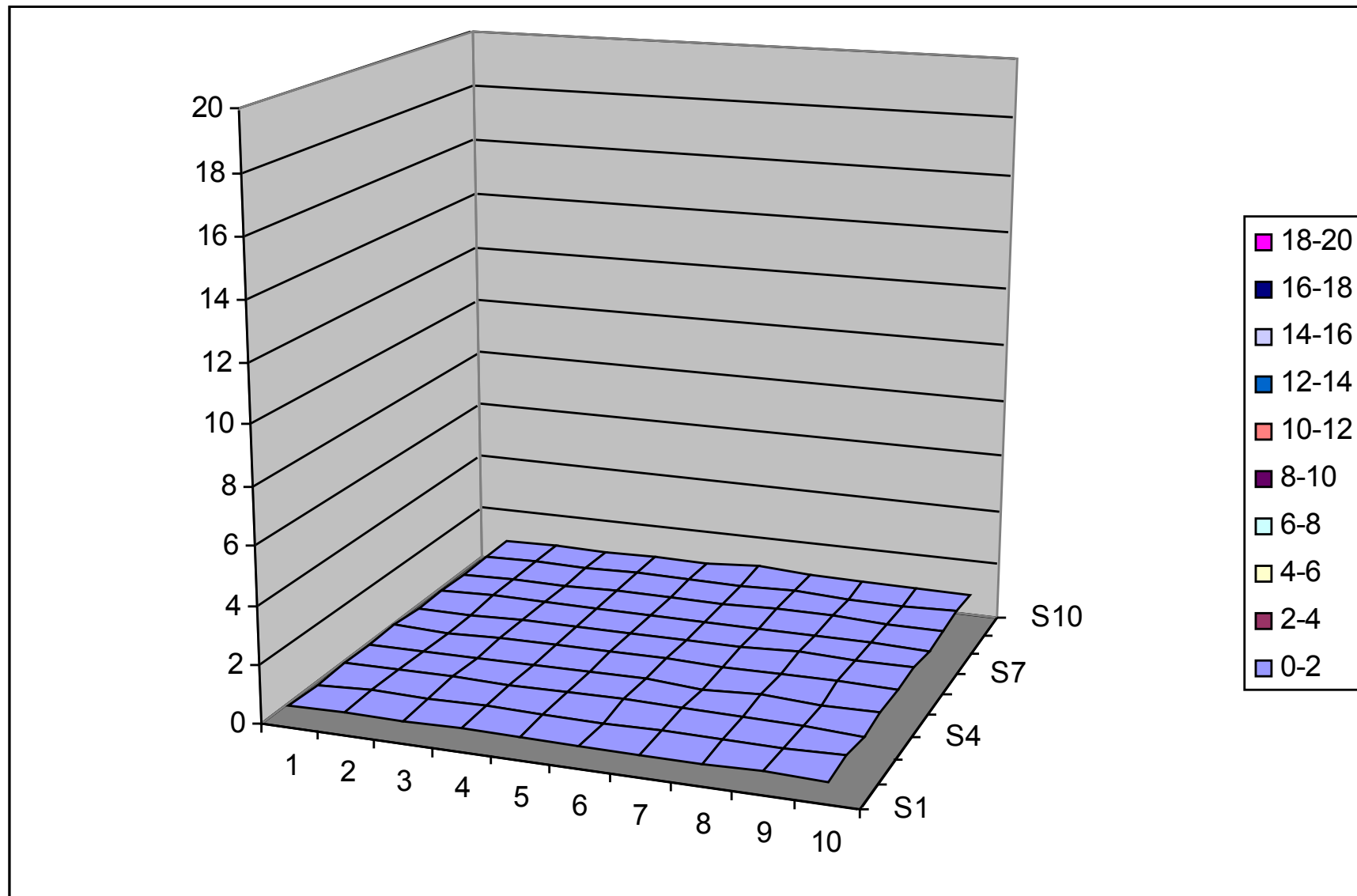
light distribution on SiPM, 10x10grid



light distribution on SiPM, 10x10grid

30mm

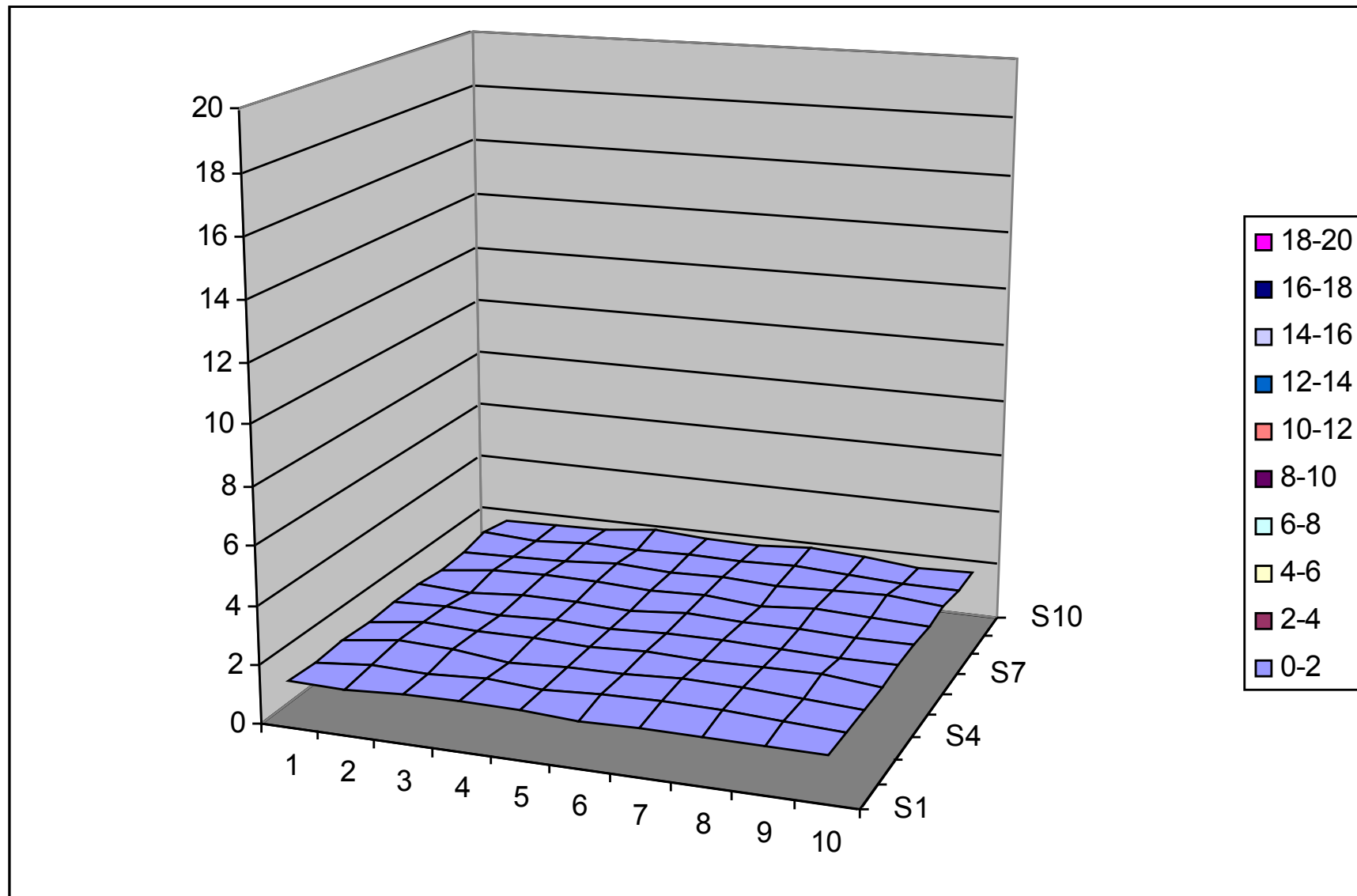
diagonal fibers



light distribution on SiPM, 10x10grid

20mm

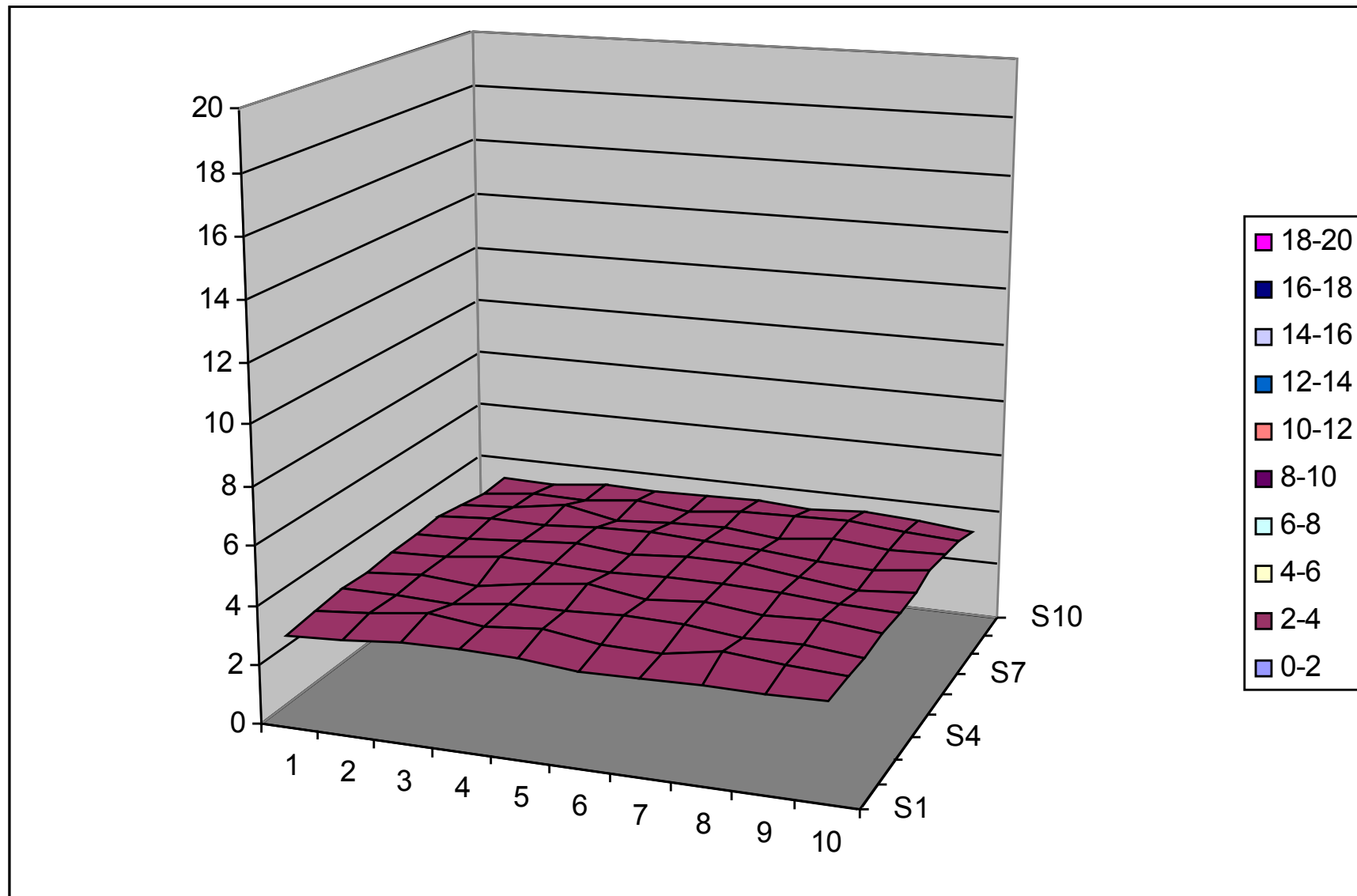
diagonal fibers



light distribution on SiPM, 10x10grid

10mm

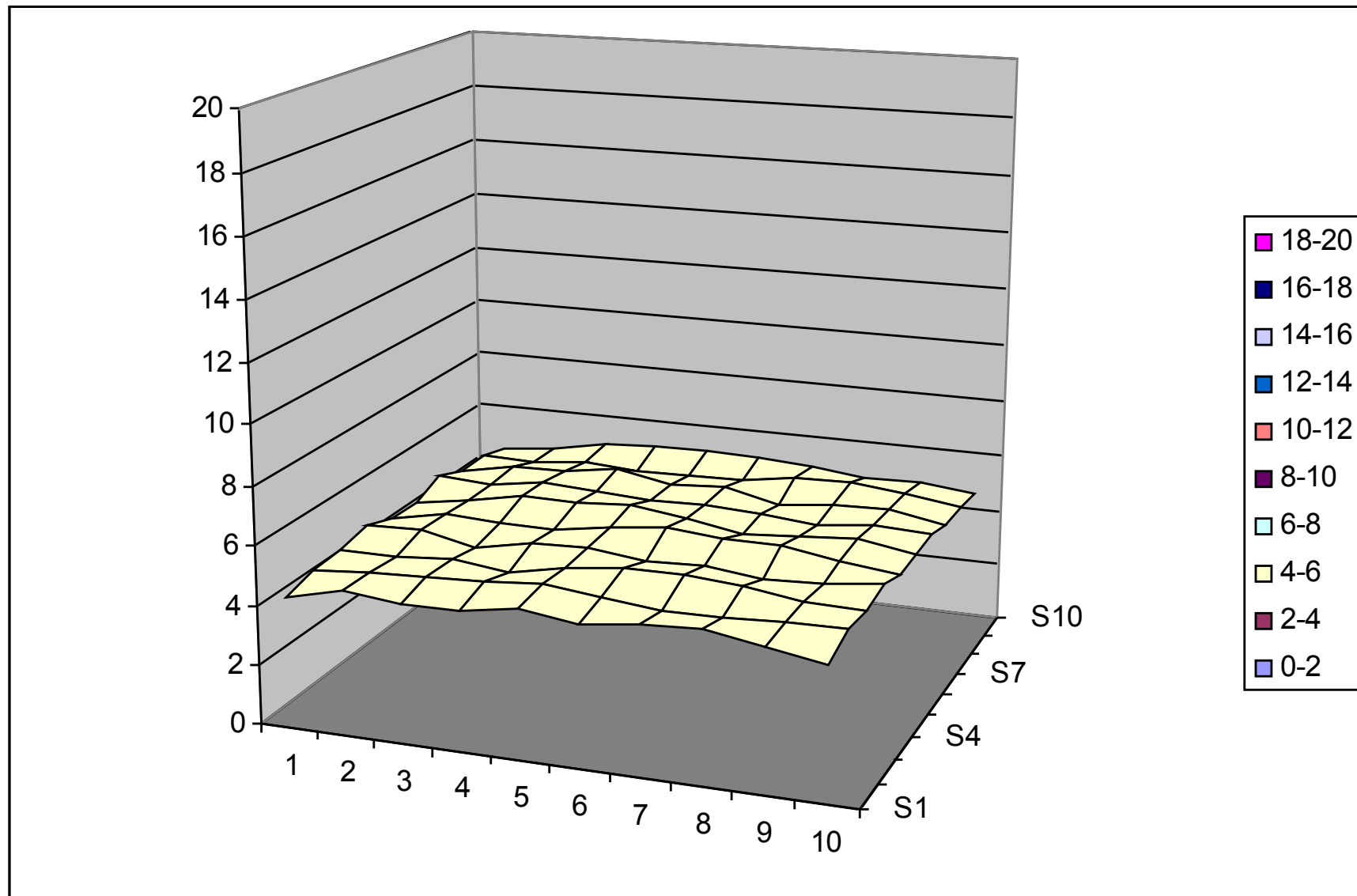
diagonal fibers



light distribution on SiPM, 10x10grid

5 mm

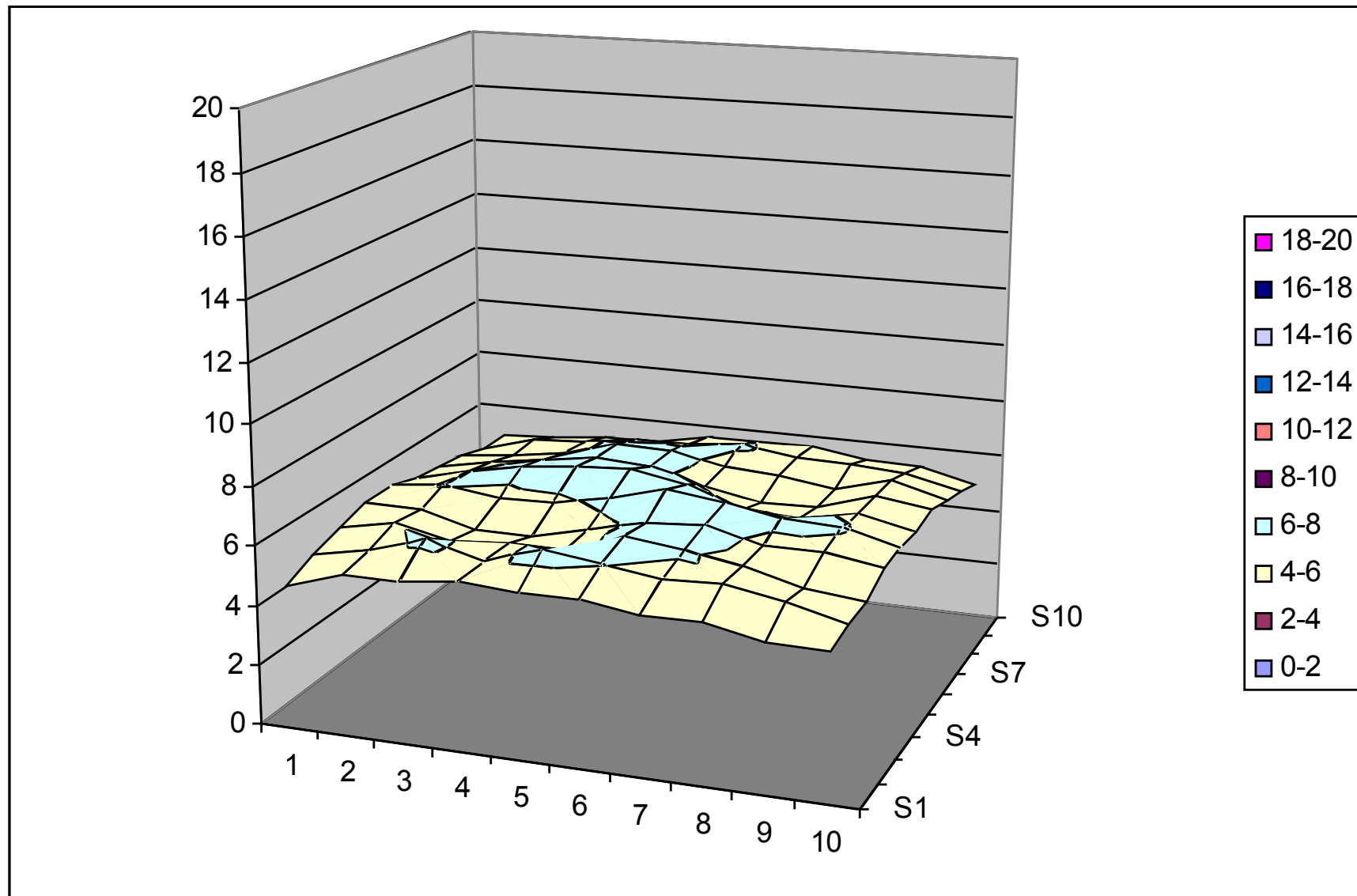
diagonal fibers



light distribution on SiPM, 10x10grid

3mm

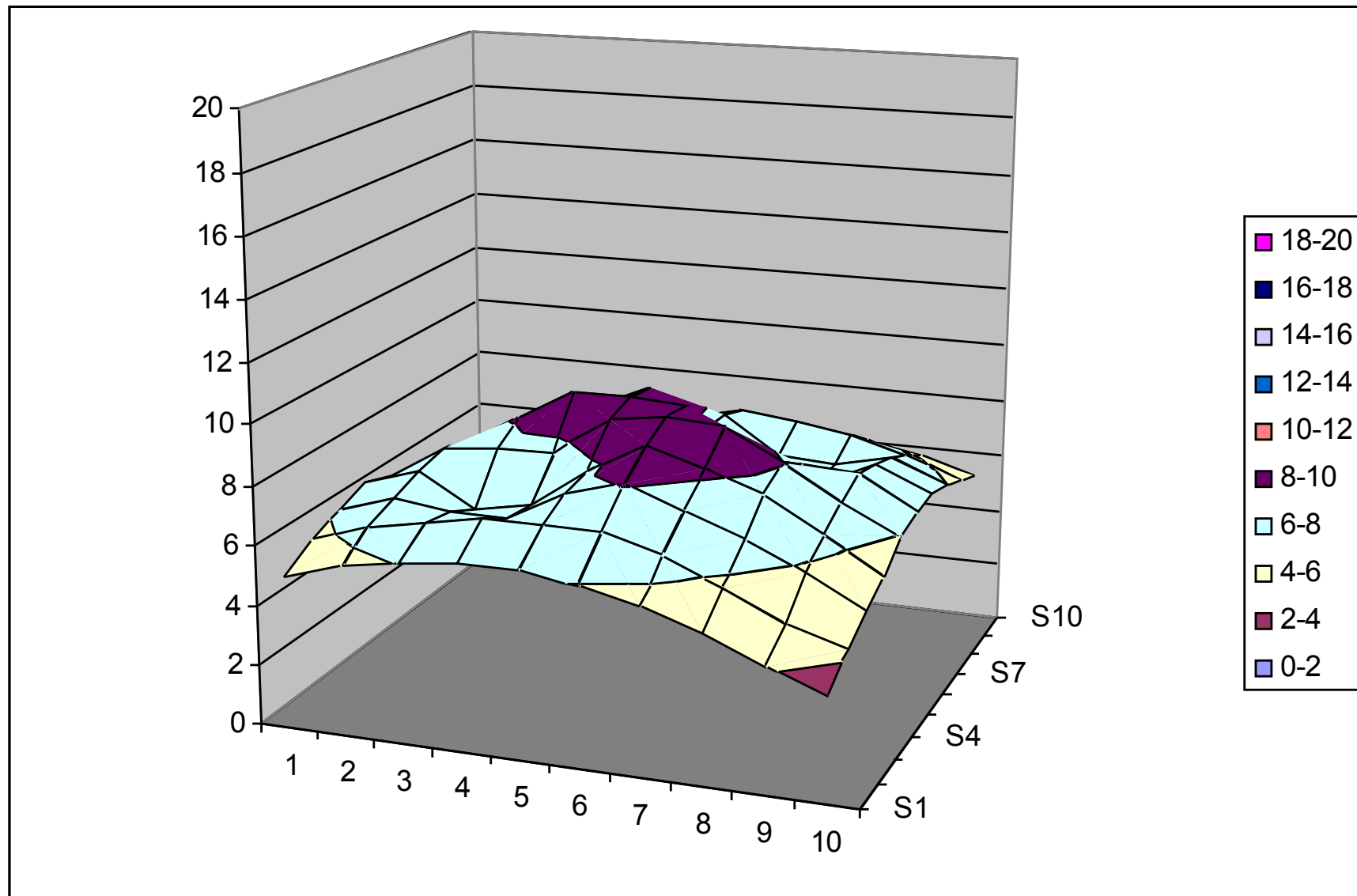
diagonal fibers



light distribution on SiPM, 10x10grid

2mm

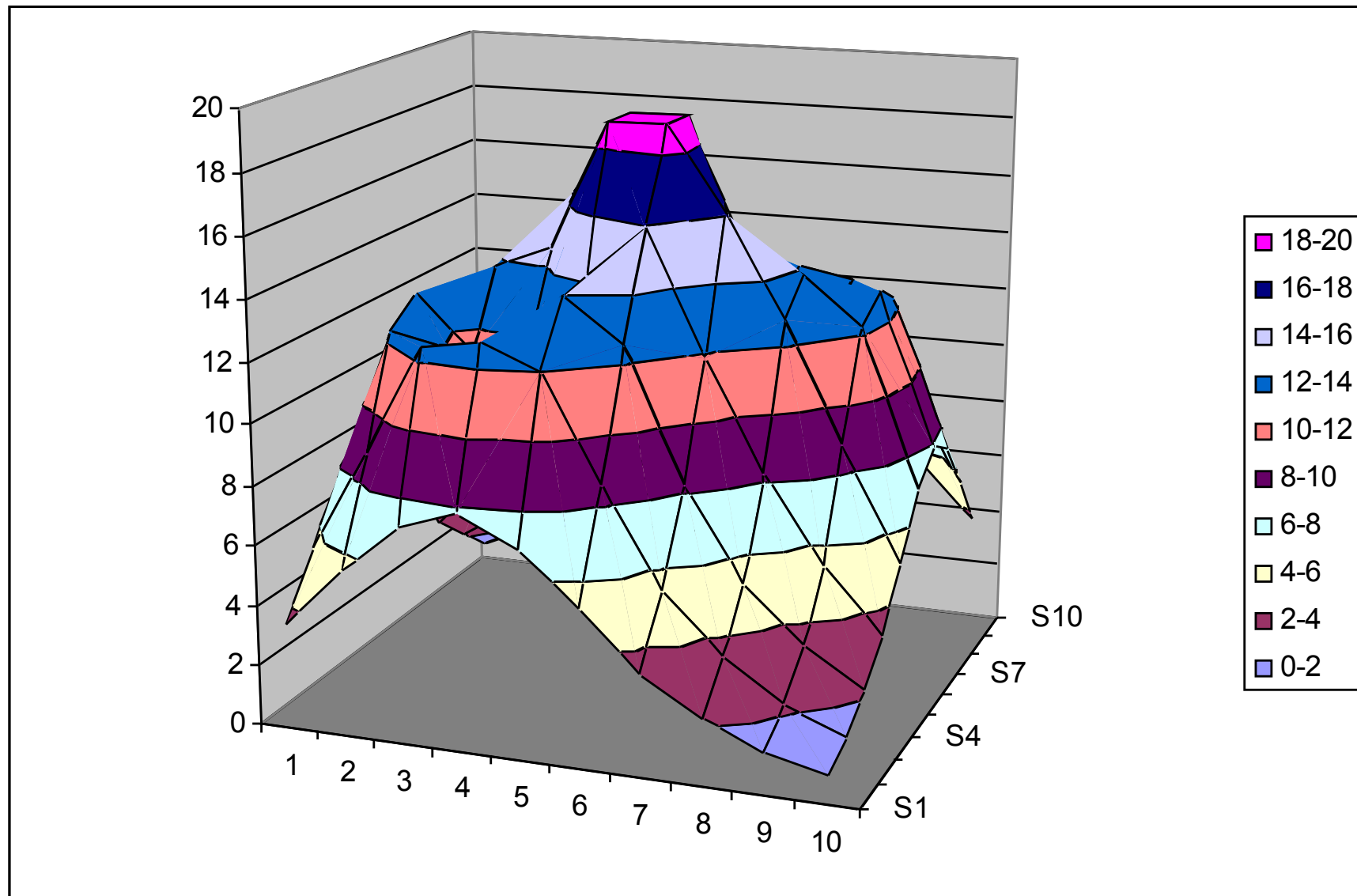
diagonal fibers



light distribution on SiPM, 10x10grid

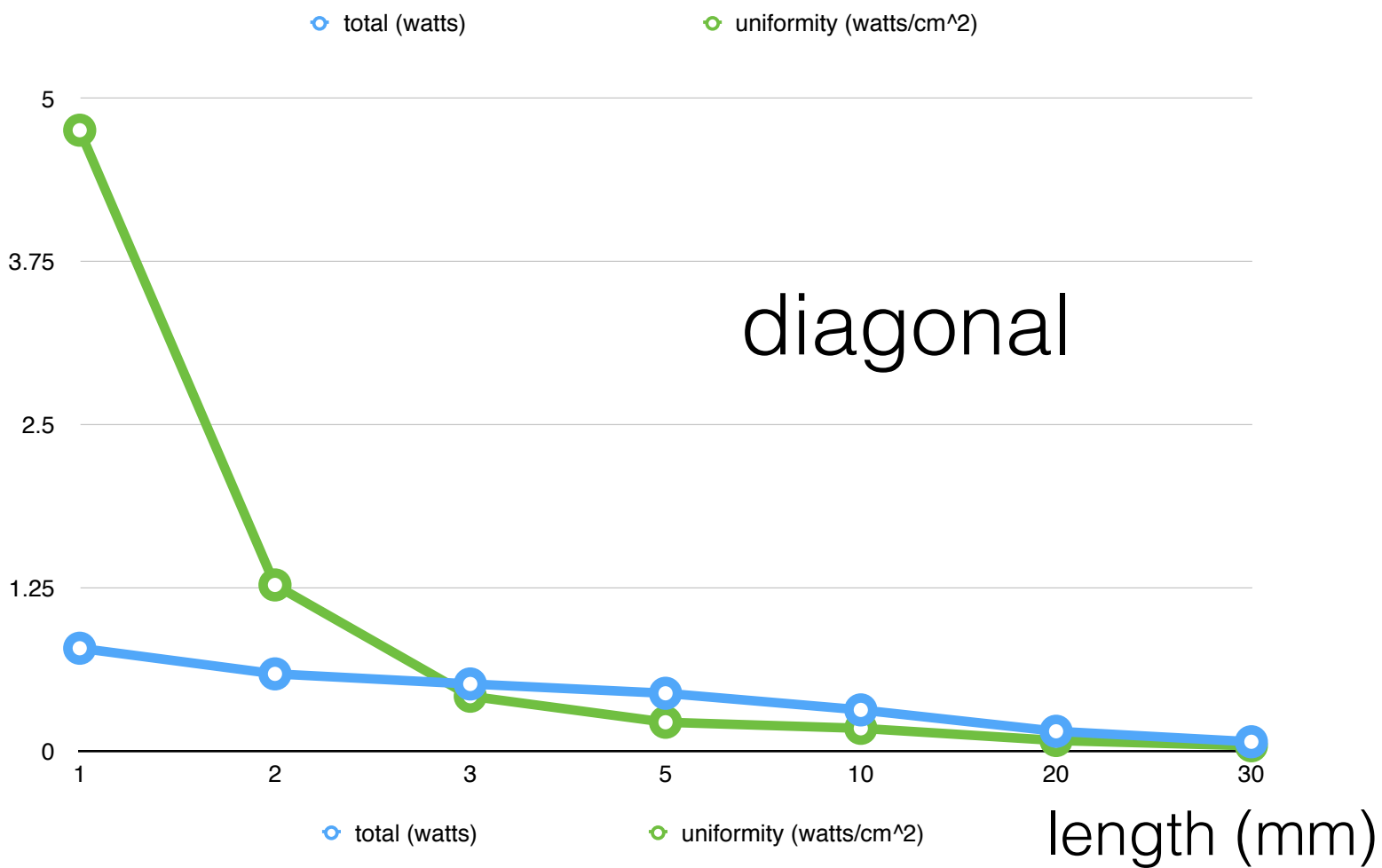
1mm

diagonal fibers

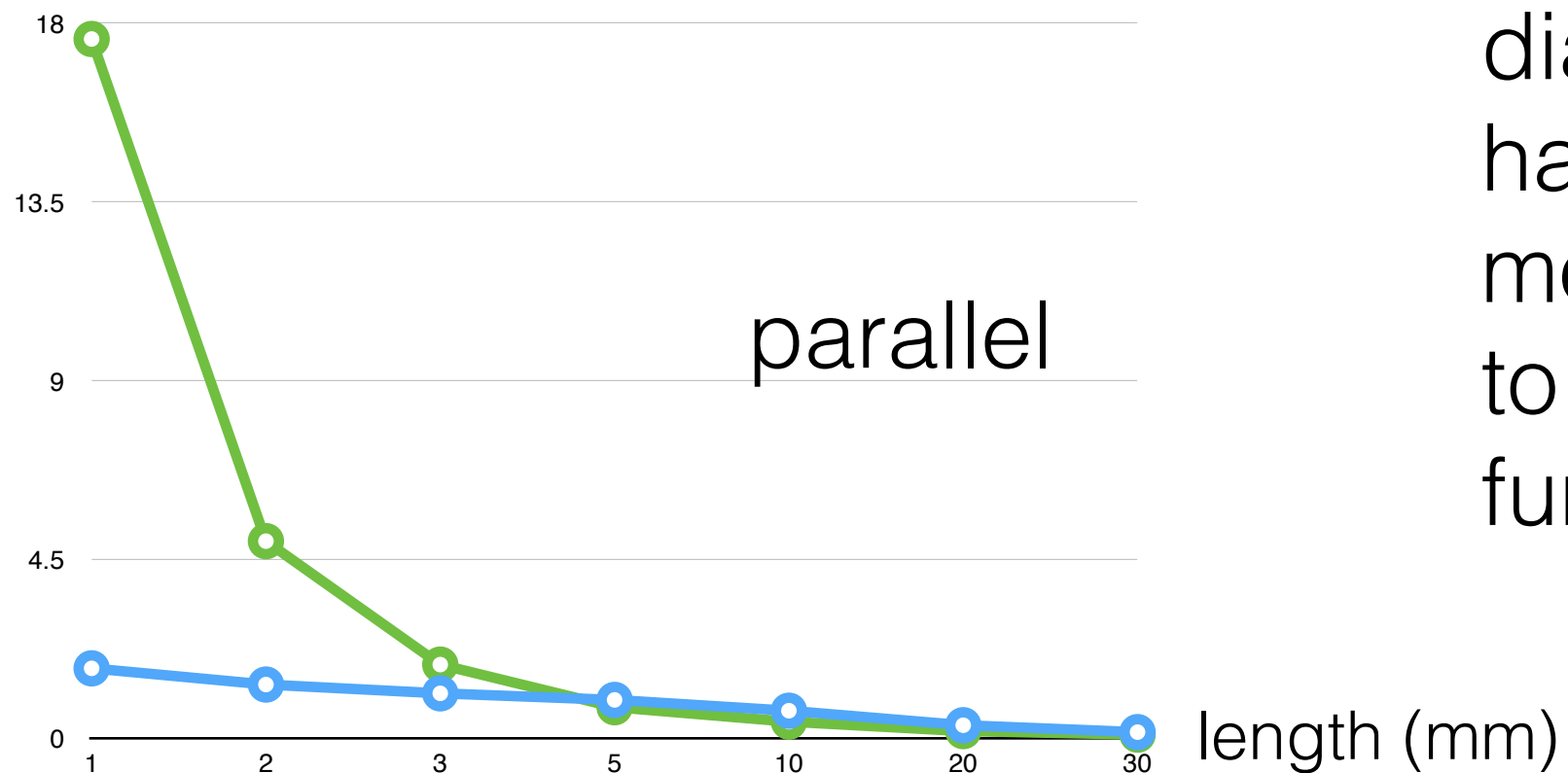


need to investigate the different patterns with the parallel
versus diagonal fibers.

Could be the way the light is emitted inside the fiber
currently 600 rays vertically with 60° full angle
and 600 rays horizontally with 60° angle



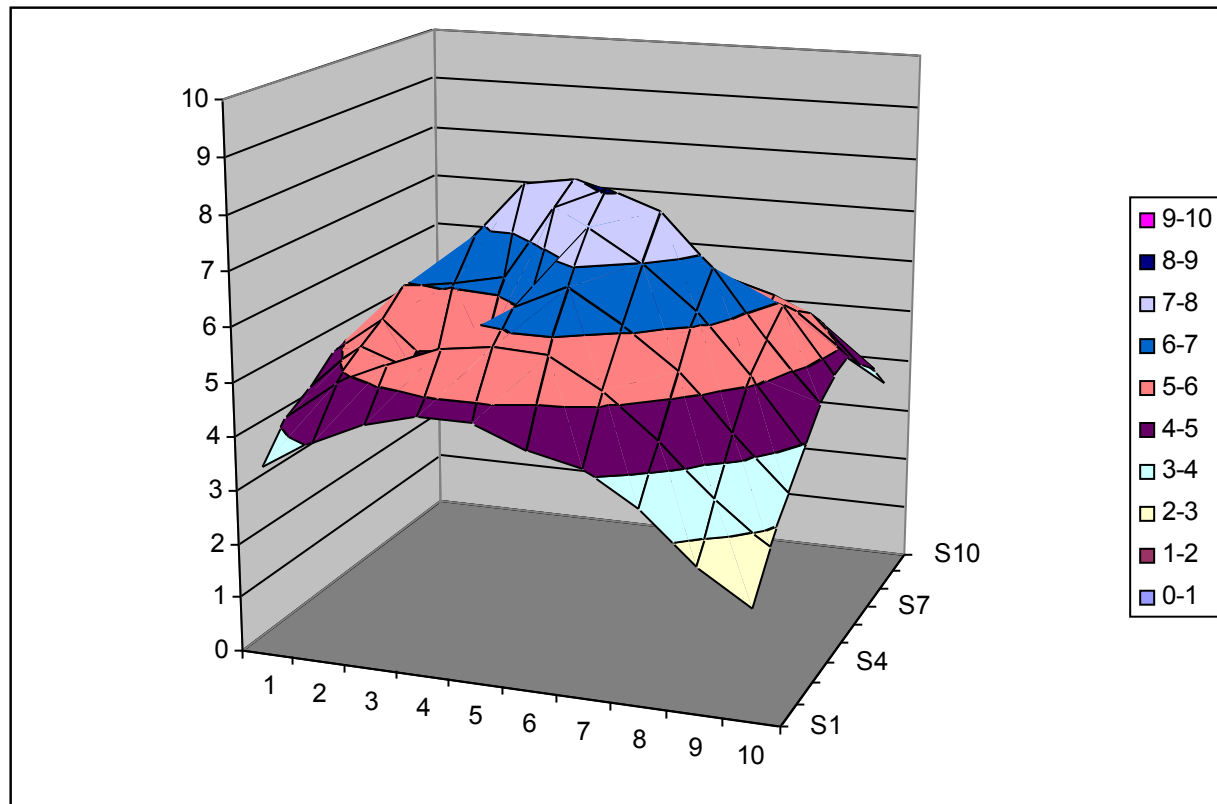
Intensity (blue) and
(rms) uniformity (green)
versus box length



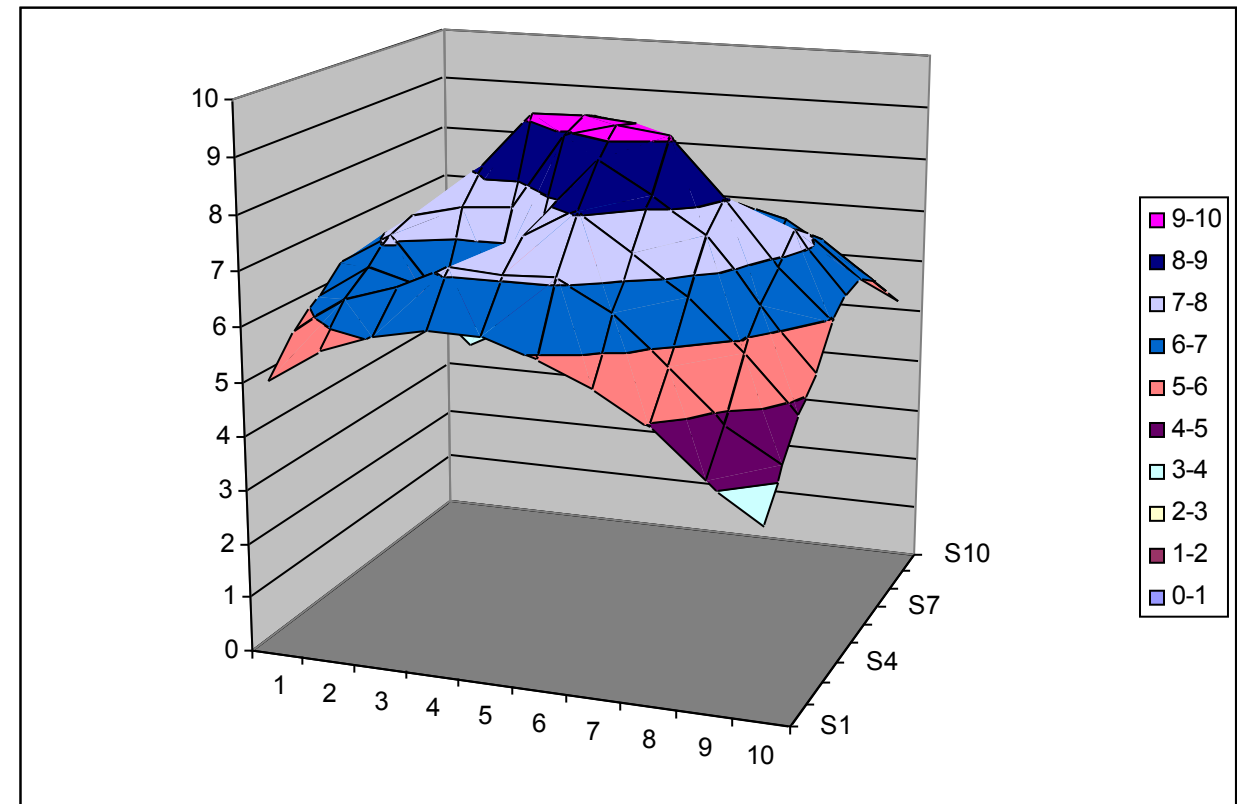
diagonal arrangement
has lower intensity but
more even distribution,
to be investigated
further

reflective versus black walls

2mm black



2mm reflect.



light yield higher and
distribution more flattened for reflective walls

Summary

once we have a more detailed design, these simulations can help decide further details like length and shape.

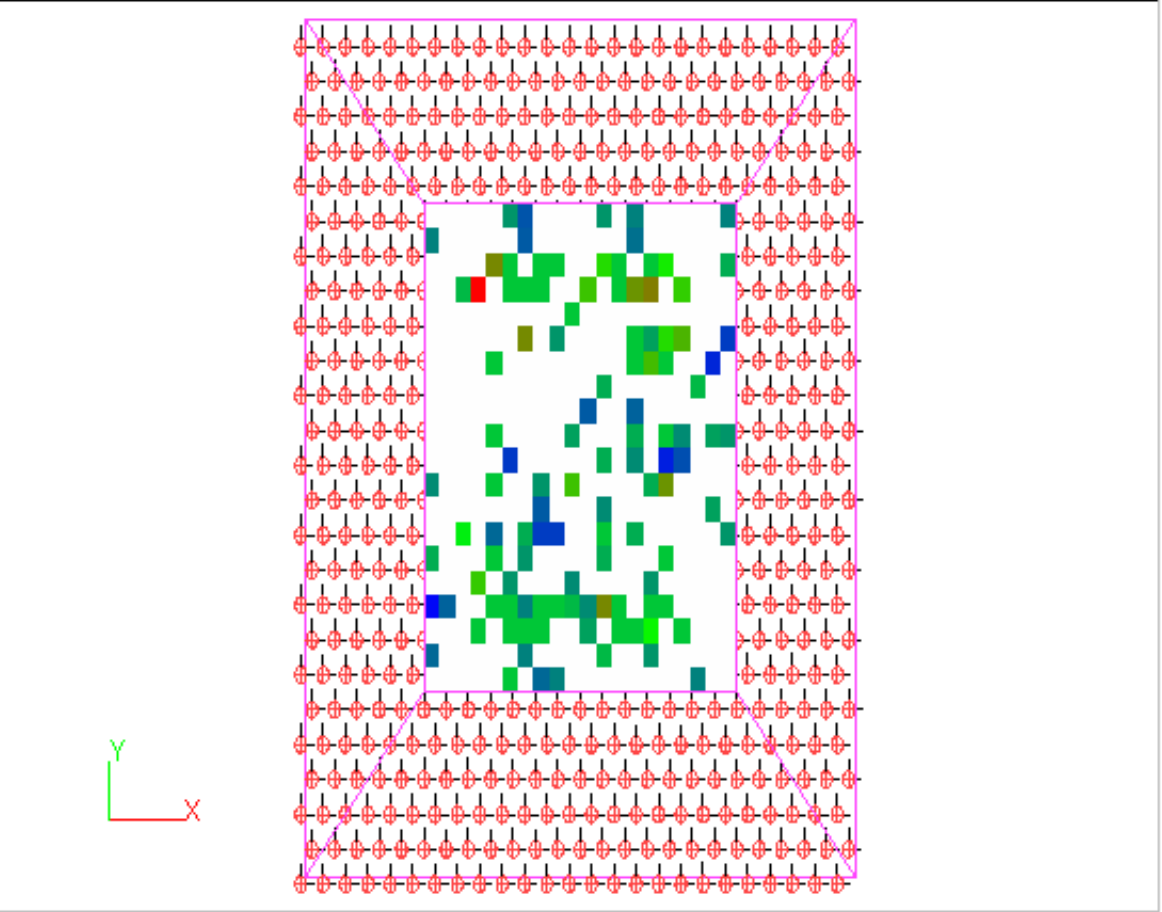
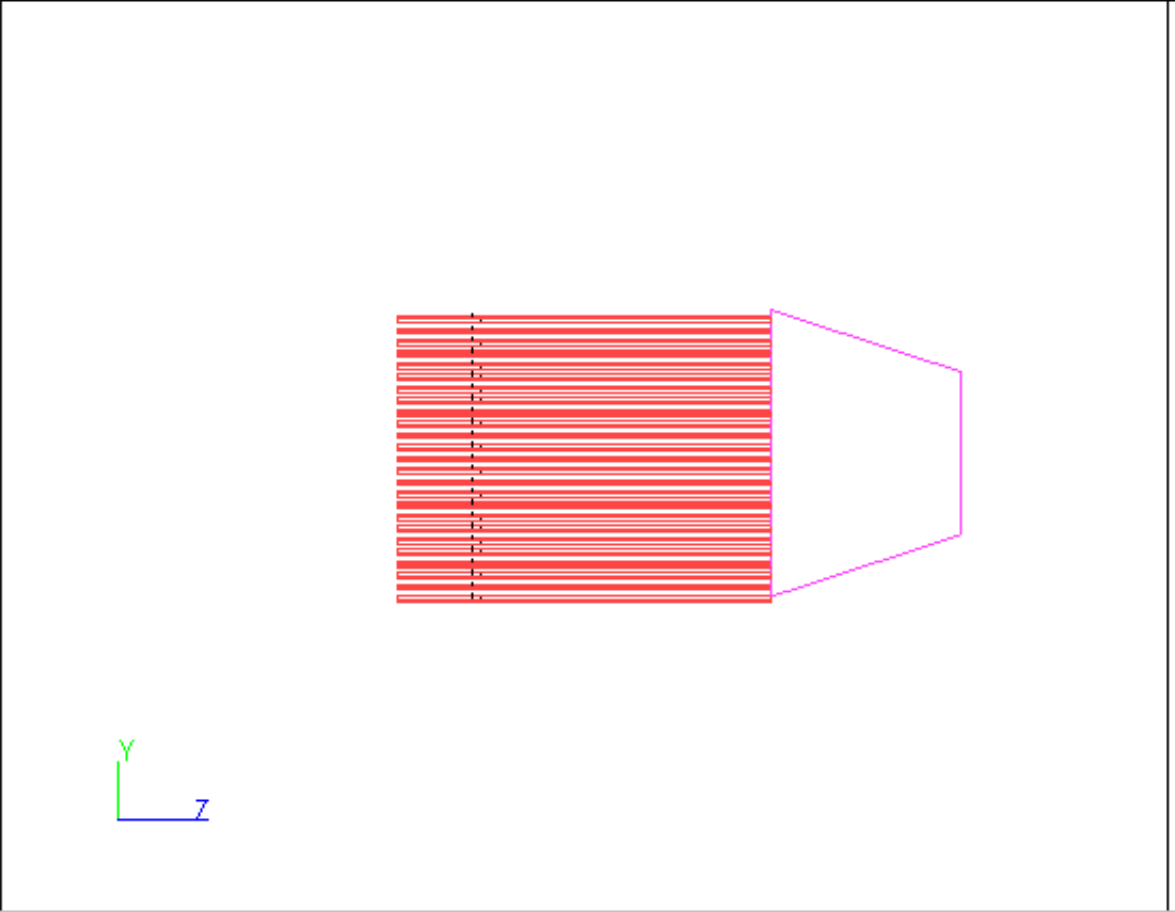
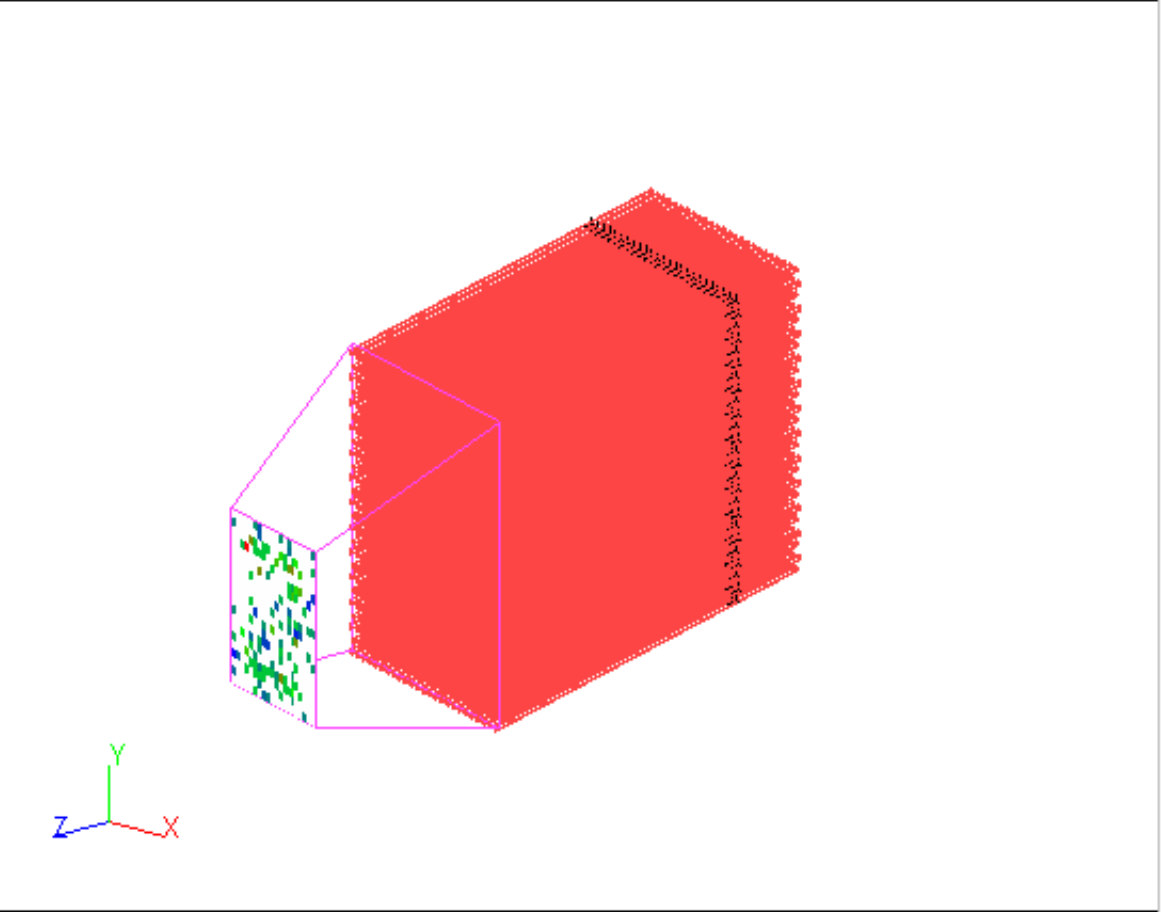
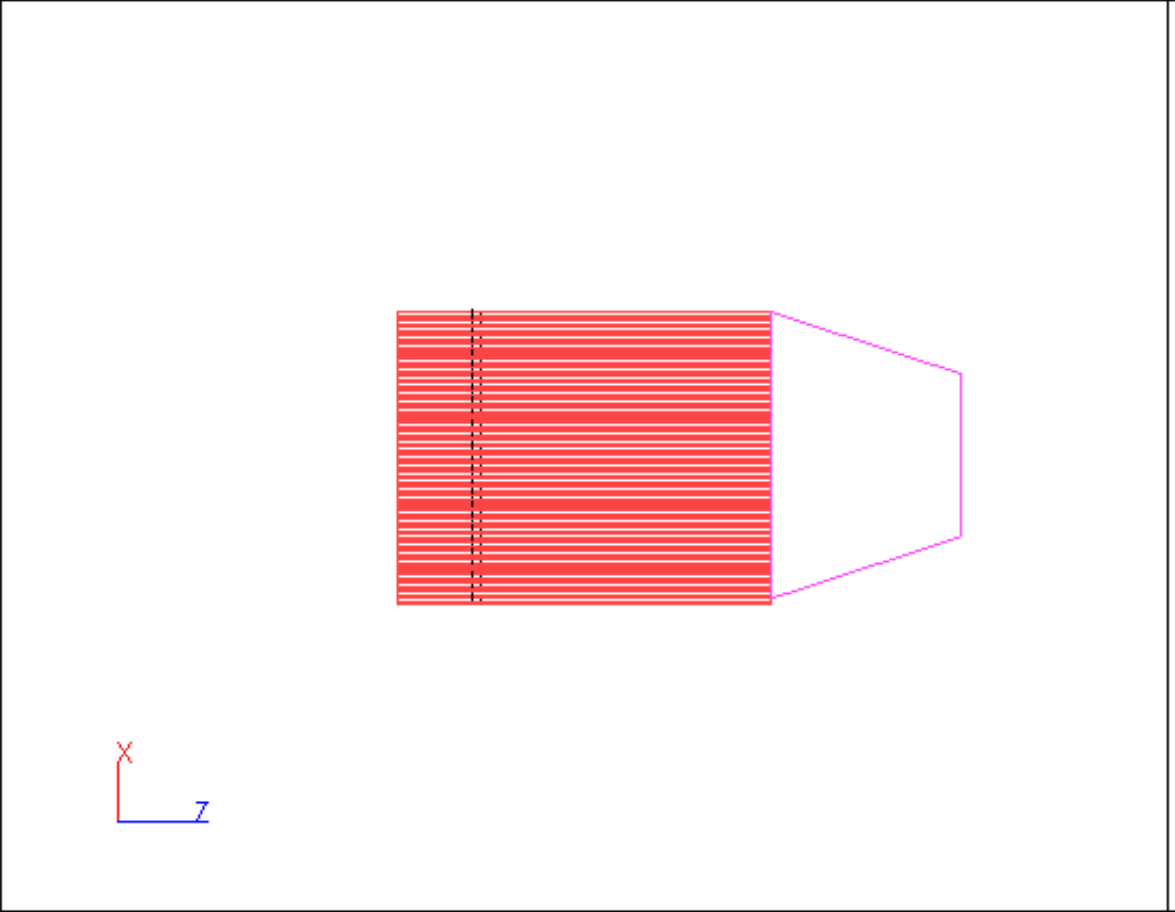
more studies necessary, e.g. light ray distribution from the source

can't get square fibers to work, need to investigate

Extras

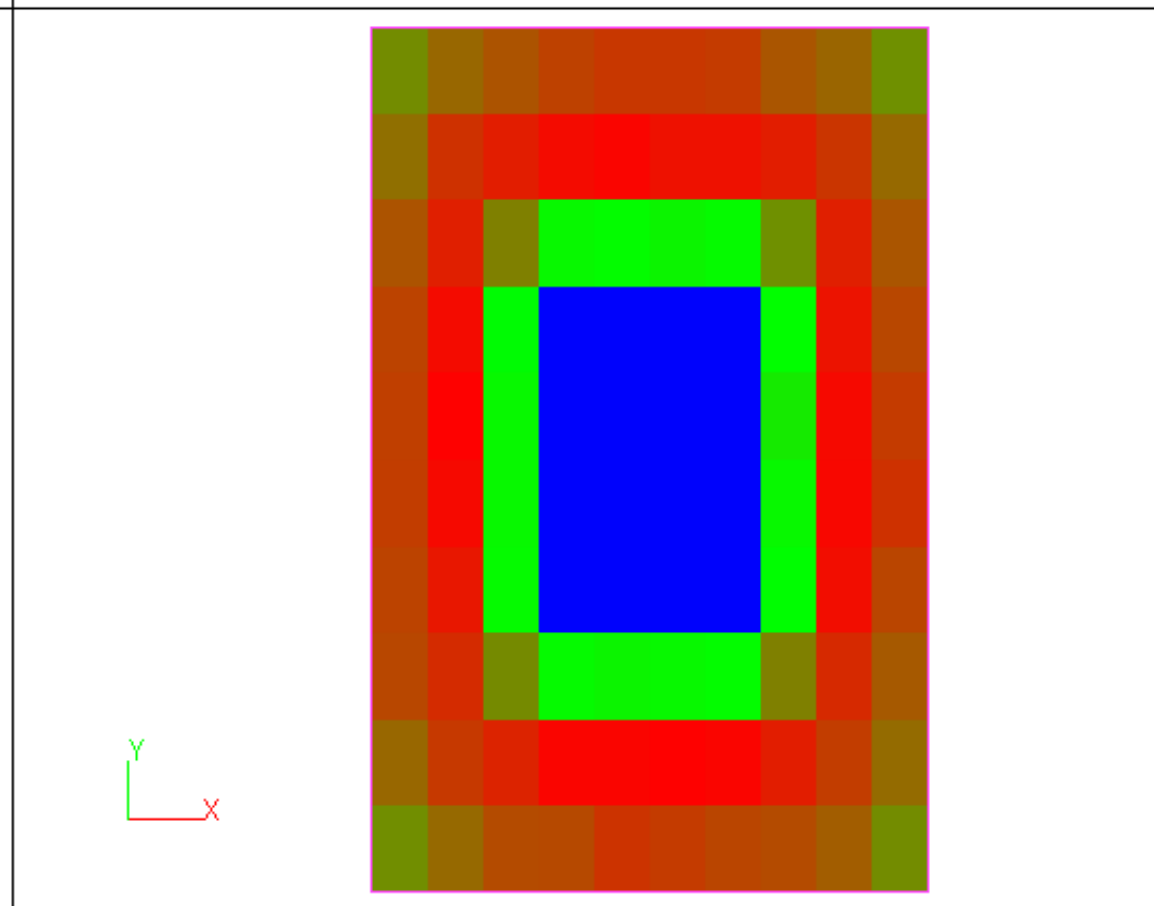
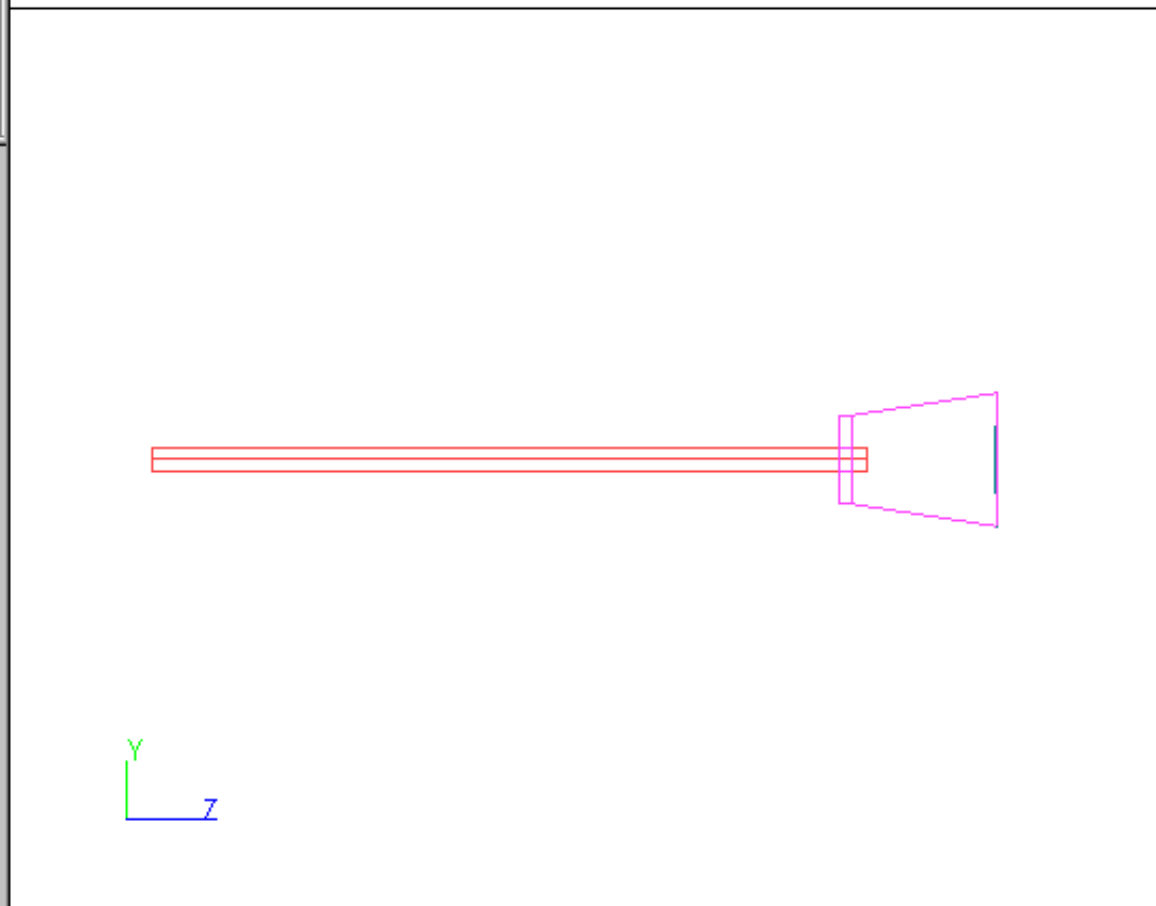
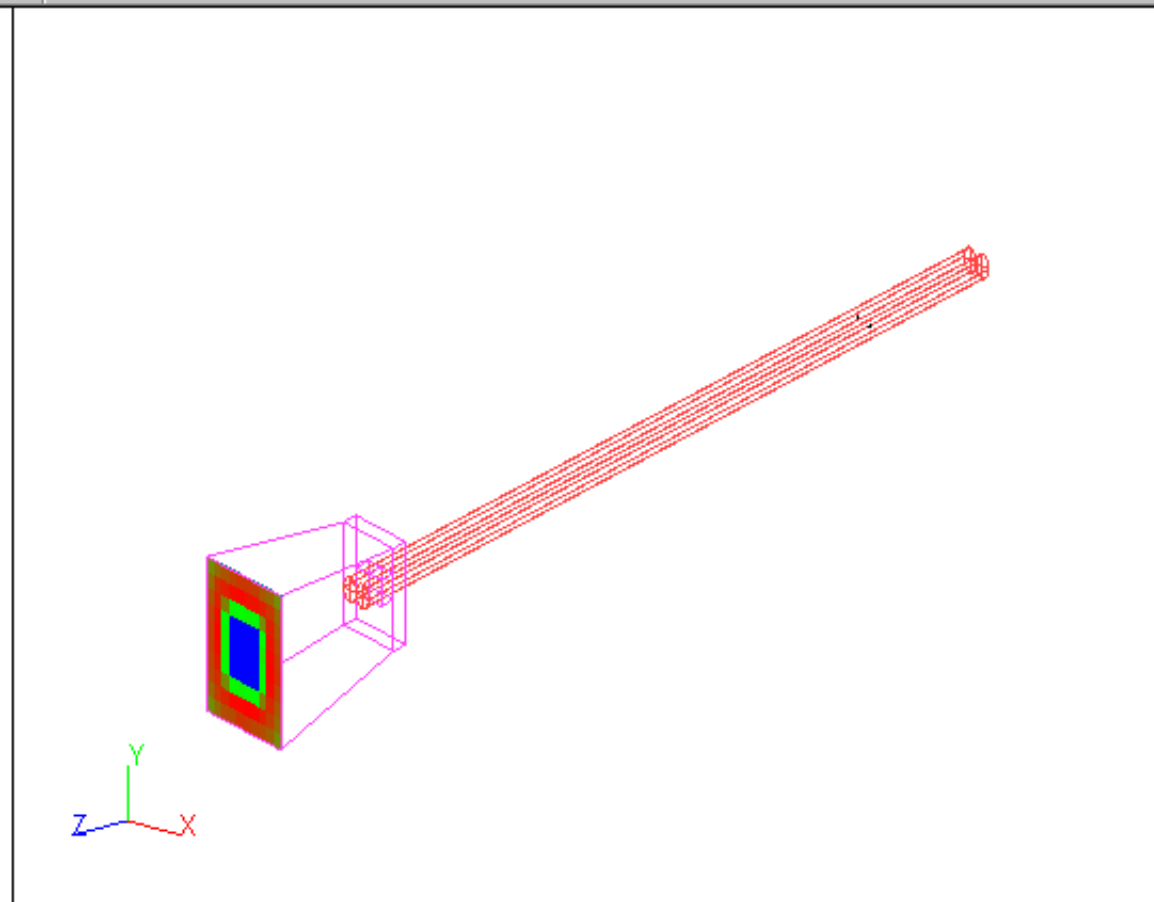
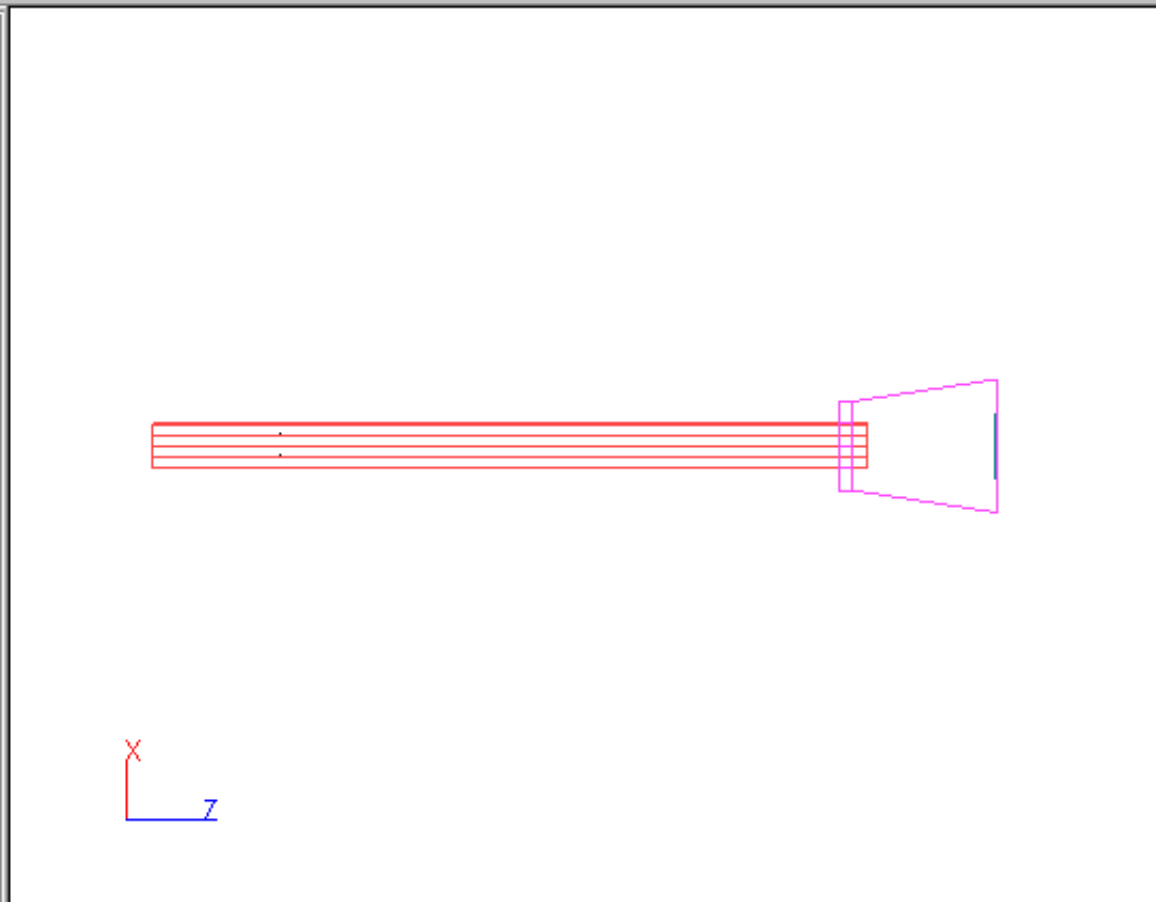


OptiCAD objects



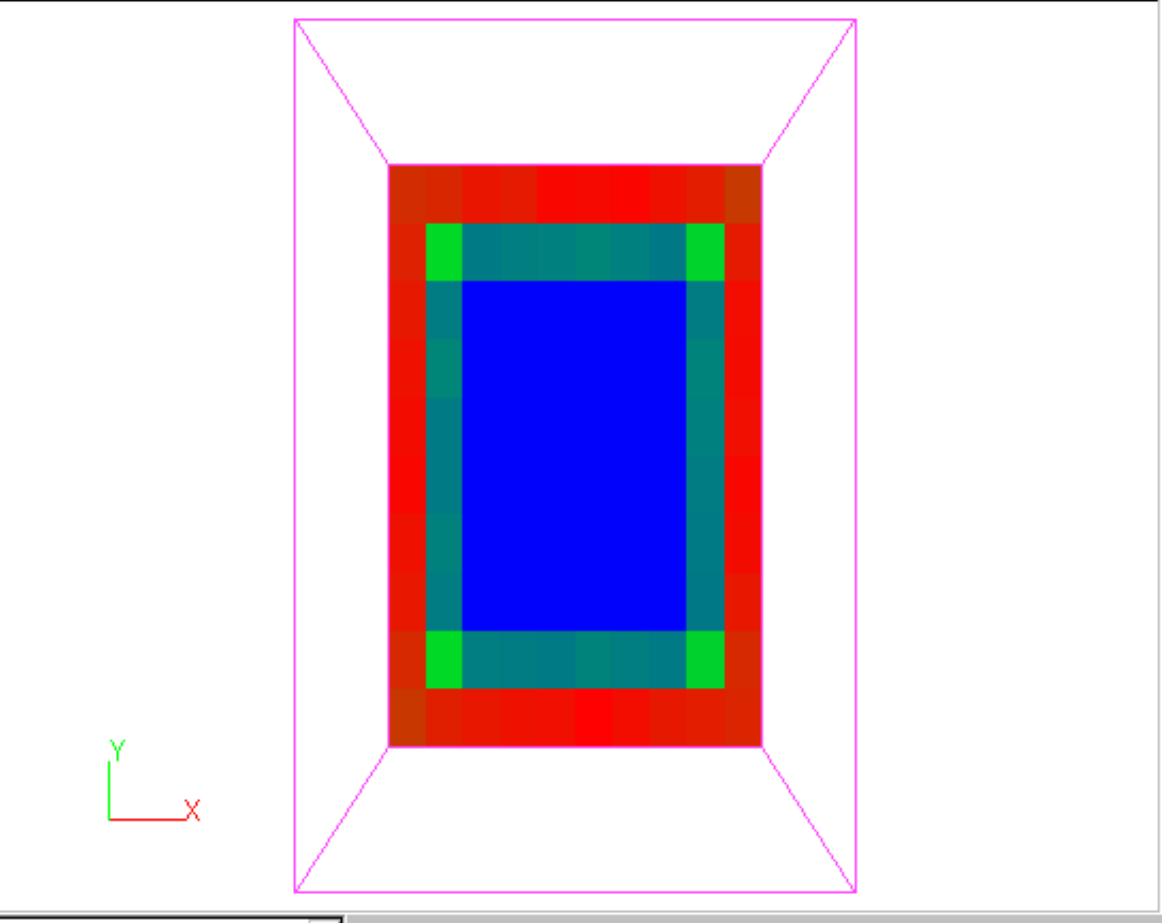
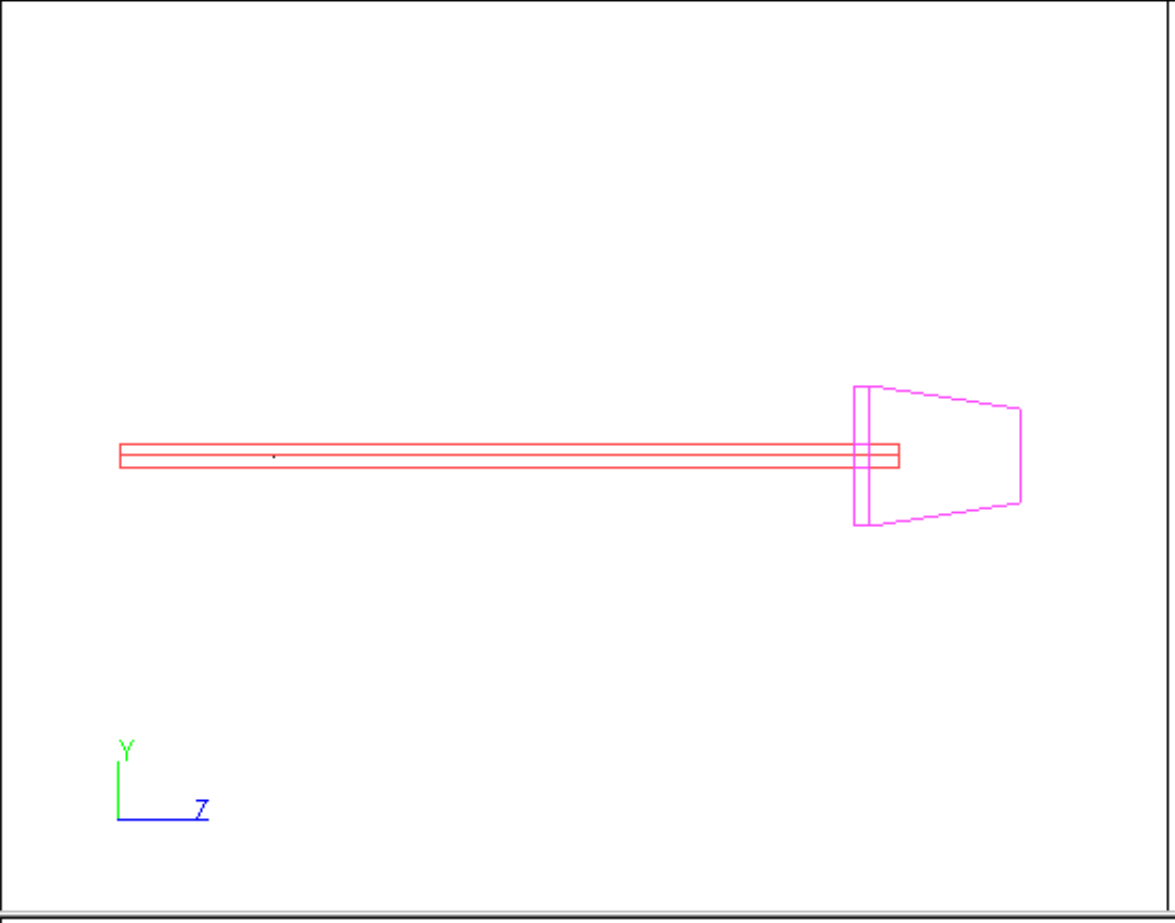
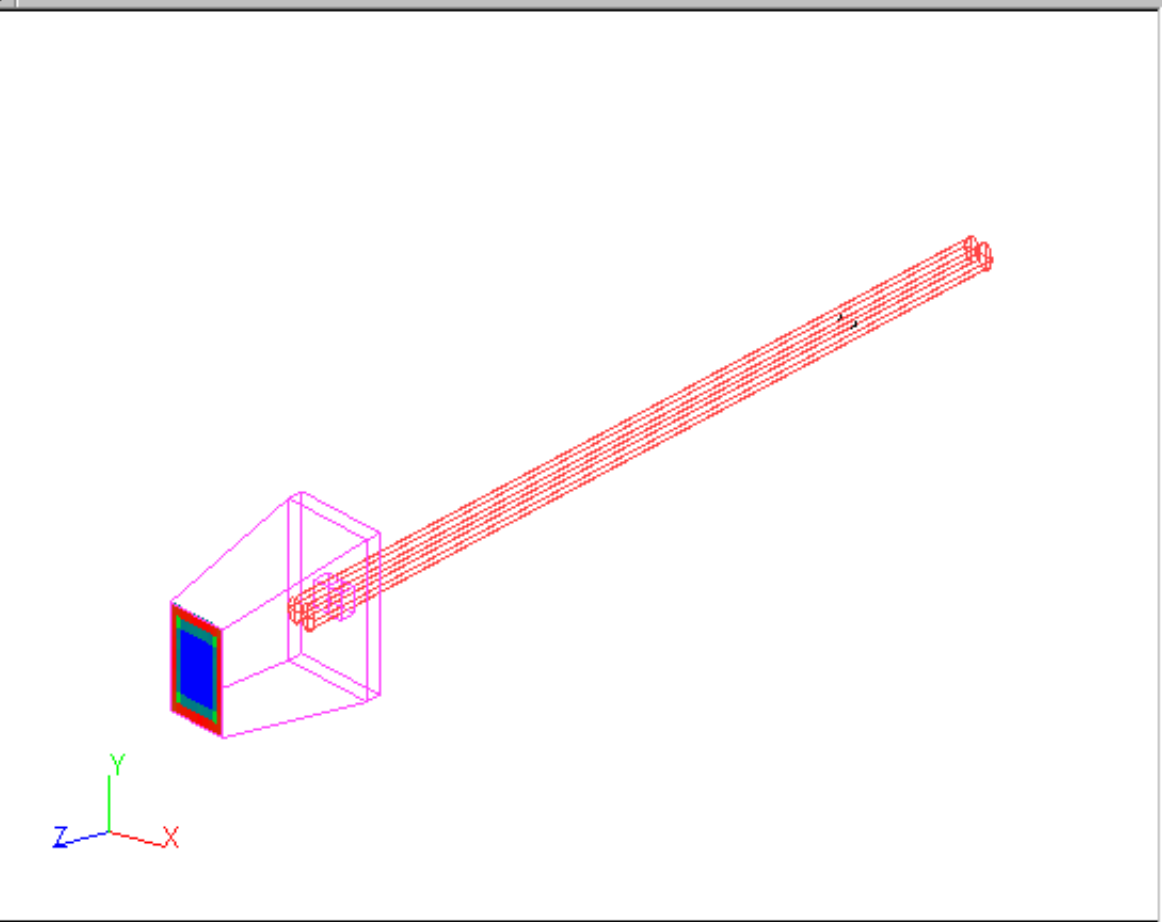
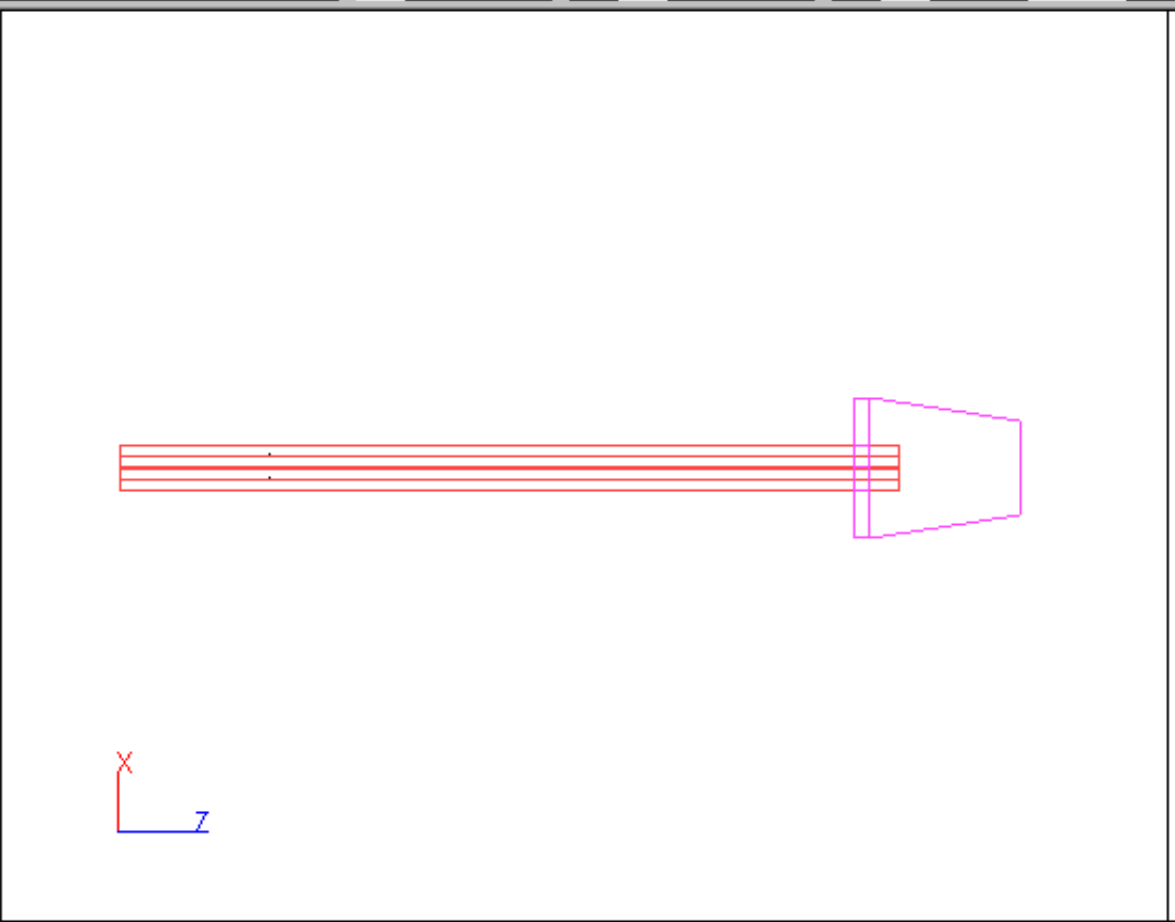
=>radiometer/attach_irradiance □film1□ 20 20 0 0 0

- OptiCAD objects**
- film1(film)
 - film2(film)
 - lid(polynet)
 - box(polynet)
 - clad0-0(rod)
 - core0-0(rod)
 - light0-0(lightsource)
 - clad1-0(rod)
 - core1-0(rod)
 - light1-0(lightsource)



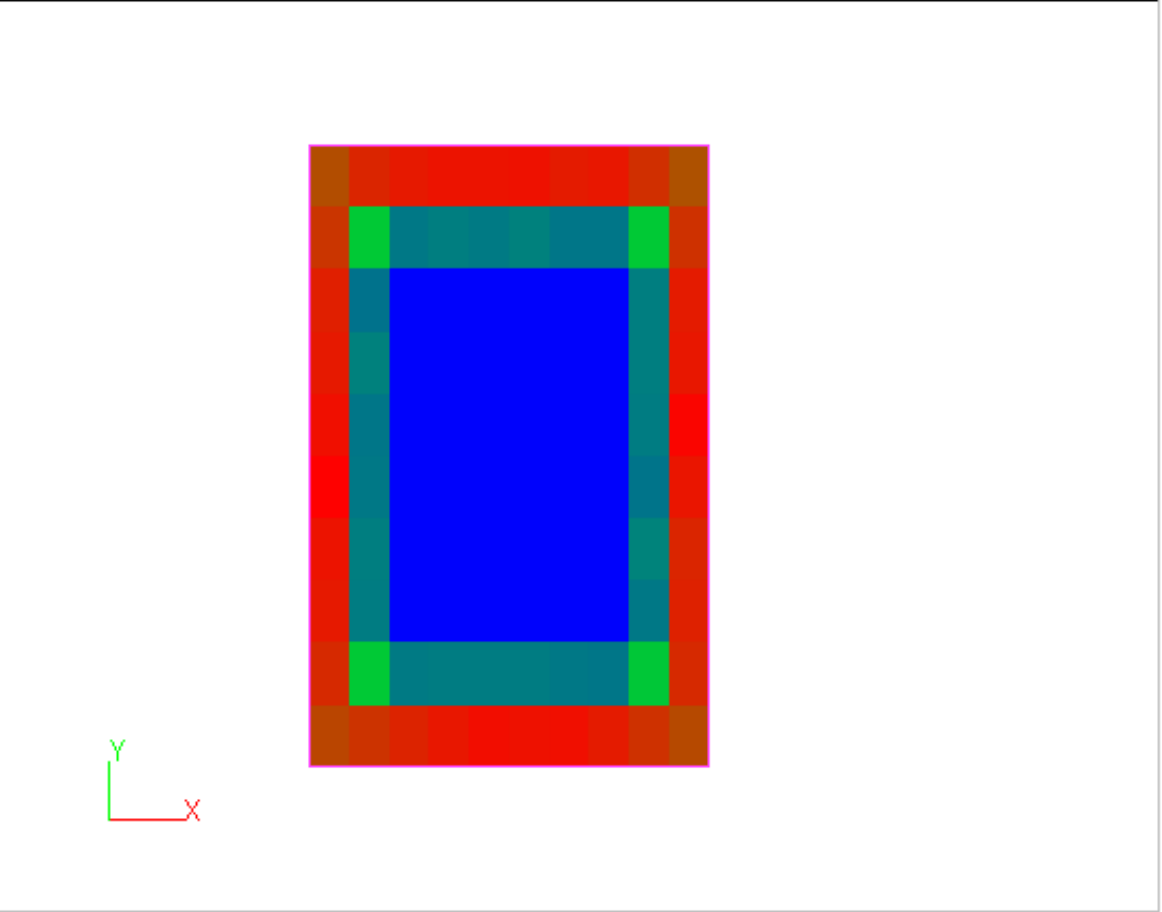
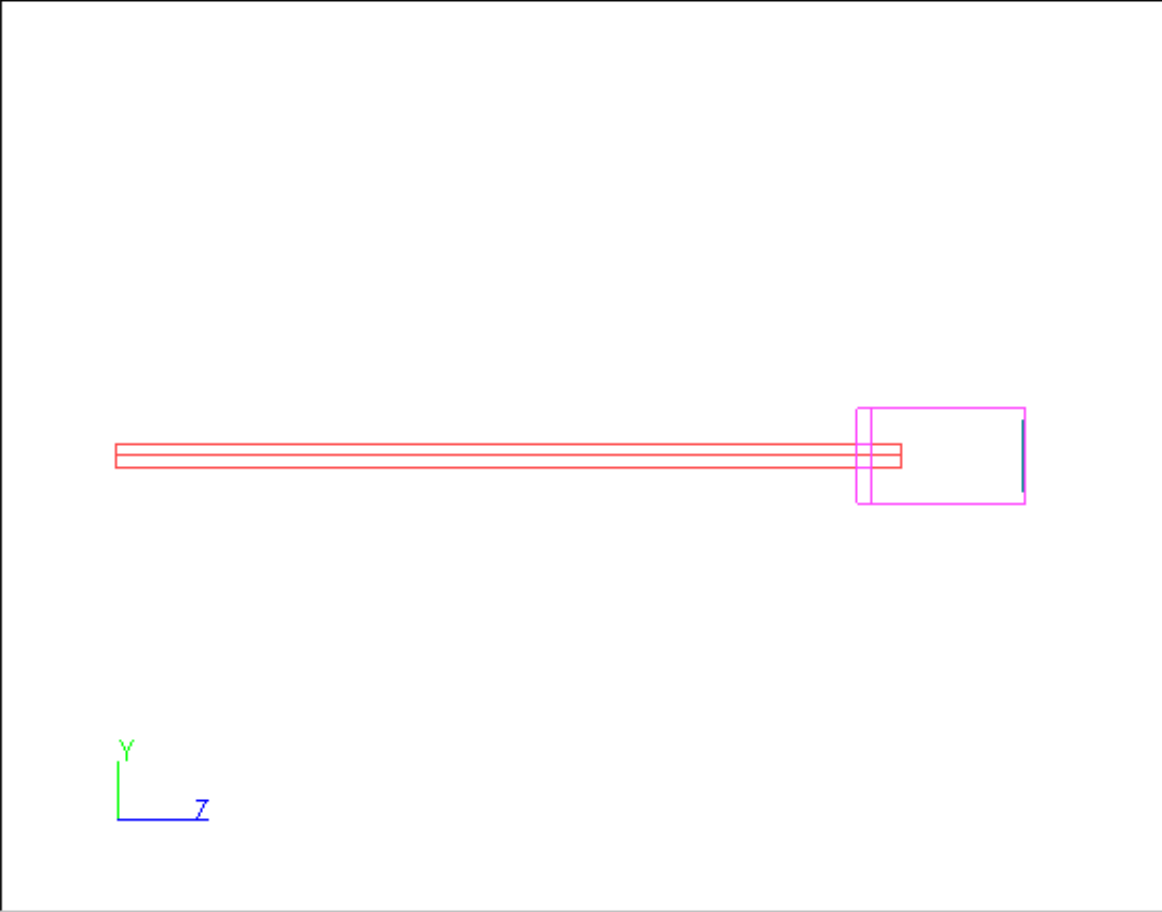
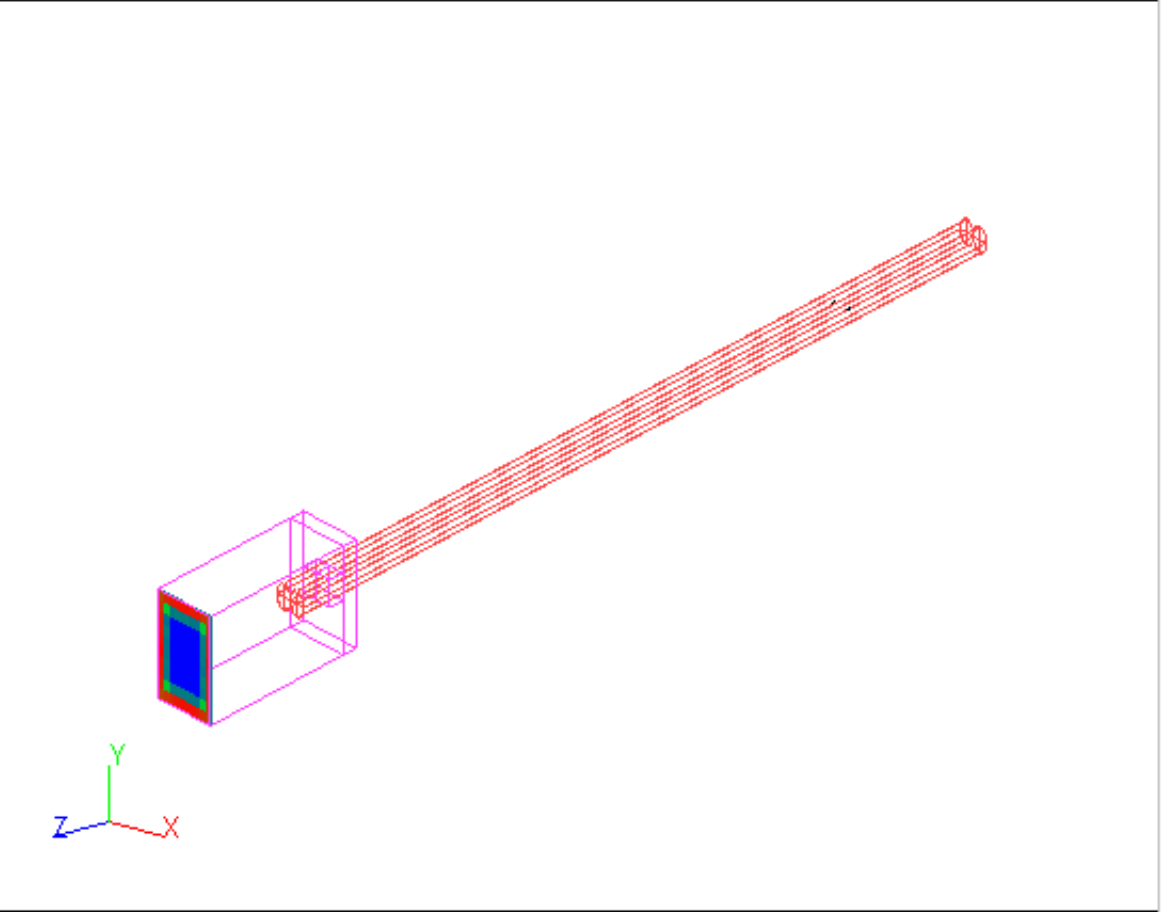
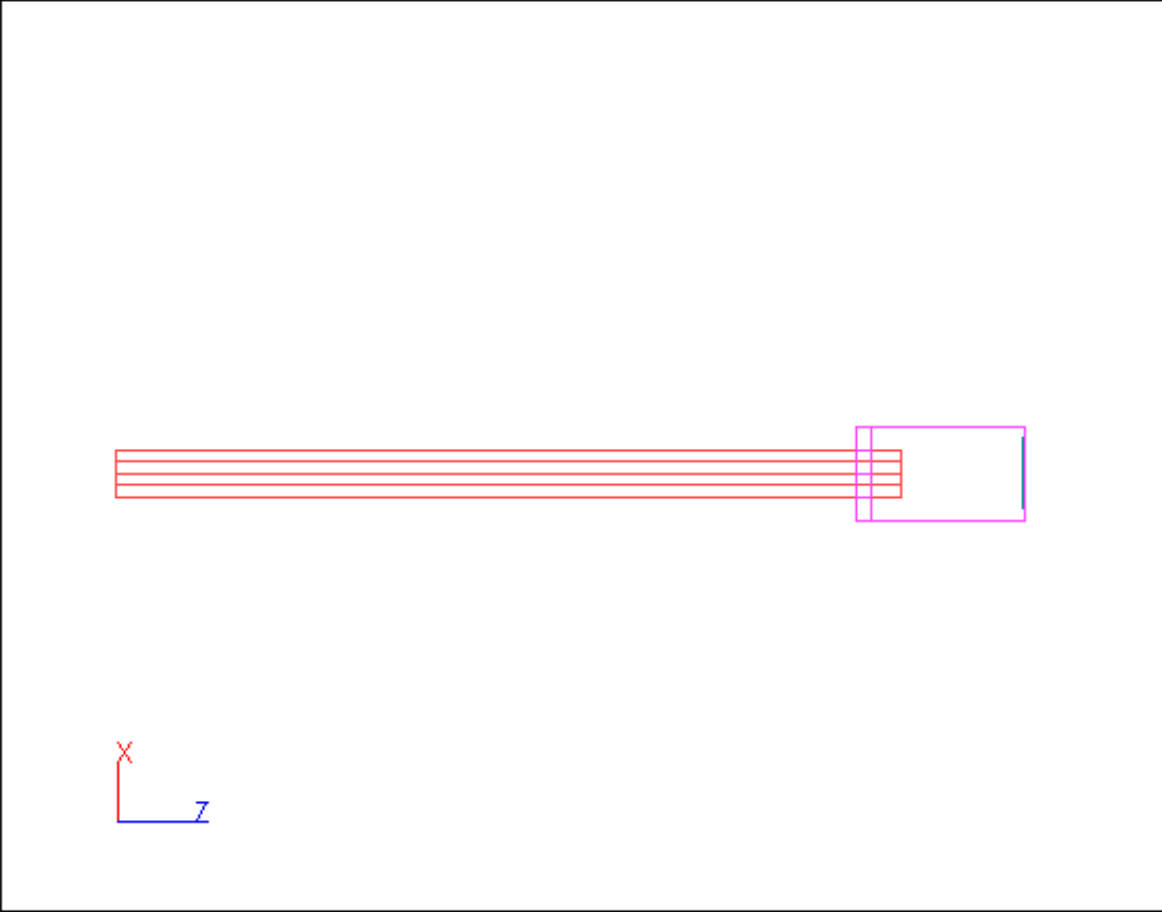
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